F O R E W O R D

The development of prawn fisheries in India has been so rapid that it has become the worlds foremost capture fishery for prawns within the past 15 years. The export earnings from prawn and prawn products have increased from Rs. 3 crores in 1960 to Rs. 75 crores in 1974. This phenomenal development is, no doubt, the result of the increased exploitation of the resources brought out by the national development plans. The process of this development has been systematic and through the efforts of the various research Institutes it has been possible to gather essential minimum data on the distribution pattern of exploited species and the rate of their exploitation. This tempo of the development of the capture fishery can be kept up only if we possess detailed data on the intensity of exploitation of the concerned species and its effect on the stock from all the centres. It is with this object the all India Co-ordinated Research Project on 'Studies on Marine Prawn Biology and Resources' was started as a supplimentary programme of the Central Marine Fisheries Research Institute.

The Project has brought out considerable data on the Prawn resources of the Country within 40 meters depth-zone and on the Biology of the concerned species, particularly from the east coast from where only scanty information were available. The tagging experiments conducted by the Project have indicated the migratory pattern and growth rates of some of the exploited species. Besides, considerable data on the recruitment pattern, spawning seasons and other biological factors have also been obtained and these information will go a long way in evolving suitable management measures for the judicious exploitation of our prawn resources to the best advantage.

The efficient execution of this Project has become possible by the combined efforts of the staff of the Project and of the Crustacean Section of the Central Marine Fisheries Research Institute together with the unfailing co-operation rendered by the Directorates of Fisheries of the maritime States of Maharashtra, Goa, Tamil Nadu, Andhra Pradesh and Orissa.

I must record here the arduous responsibilities sholdered by Dr. P. Vedavyasa Rao who in the absence of a full-fledged Project Co-ordinator helped the Director in the Co-ordination of the project programmes. A special mention should be made of the help rendered by Shri K.H. Mohamed, Fishery Scientist of Central Marine Fisheries Research Institute for liaising with the Project and project staff for finalising this report.

1/9/75

(E.G. SILAS)
Director & Project Co-ordinator

Cochin-18
1st September, 1975

TITLE PAGE

(i) Name and address of the reporting Institute : PROJECT CO-ORDINATOR'S REPORT
CENTRAL MARINE FISHERIES
RESEARCH INSTITUTE, COCHIN-18

(ii) Project title : "STUDIES ON MARINE PRAWN
BIOLOGY AND RESOURCES"

(iii) Year of Report : 1971 - 1974
(August 1971 to February 1974)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
K.C. AVENUE, P.B.No. 1912,
COCHIN - 682018

C O N T E N T S

****

I. RECOMMENDATIONS

1. Marine prawn production in the country showed increasing trend in both the years of study and this has been reflected in the export earnings of the period. Considering the importance of the fishery, particularly from the stand point of foreign exchange earned by prawns, investigations directed towards augmenting production will have to be intensified.

2. The present rate of exploitation along the east coast is relatively poor and most of the areas surveyed indicate considerable scope for further development of commercial prawn fishing in the offshore waters.

3. Penaeid prawn resources of the country occupy three different ecosystems such as estuaries, inshore seas and offshore seas. Commercial fishery for prawns is well established in all these environments at least in some of the centres. The fishery in each of these environments being interdependant, all efforts should be made to study the various factors extant in these ecosystems in relation to the life-history of the species. This line of work is likely to bring good results as indicated by the successful forecasting of the fishery made by C.M.F.R.I. from Cochin in recent years.

4. Mechanised fishing vessels are fast replacing the indigenous crafts in the capture fishery for prawns. The fast tempo of this development calls for close watch of the resources as well as the effect of exploitation at different levels in order to frame management policies and conservation measures, if found necessary. This can be possible by obtaining accurate data on catch and

effort, gears introduced from time to time and biological characteristics of the constituent species. Presently the related informations are being obtained by random sampling from widely separated centres. It is essential that data obtained like this are subjected to tests with the help of information obtained from other sources. For this, it would be necessary to have statutory provisions requiring the commercial vessels to file periodic returns about their catches and operations. Action of this nature can only be initiated by powerful bodies like 'Shrimp Council' operating in other countries.

5. Our prawn fishery is a multi-species fishery, with each of the species having individual distribution patterns. This situation calls for regional monitoring of population characteristics of each species as a continuing programme in order to keep track of the effects of exploitation on stock.

6. At present the prawn fishing industry is concentrated in certain centres of the country where the level of exploitation is very high. This is perhaps due to the ease of logistics and infrastructures developed in some of the west coast centres. Extention of fishing operations to less exploited areas particularly the east coast centres is recommended.

7. Rapid dissemination of prawn fishery data for the use of the industry may be taken up. This may be effected by publishing periodic bulletins containing catch data, processing details and trade informations through appropriate channel as indicated in recommendation No. 4.

8. In order to keep proper track of events in the capture fishery for prawns and to find out new resources, it

would be necessary to have periodic exploratory cruises from different centres. It would also be necessary to conduct intensive explorations of new fishing grounds as well as those showing diminishing catch returns. This can be achieved through co-operative programmes involving organisations having different facilities.

9. In the matter of studies on population characteristics, it is most essential to delimit the stock. One of the sure ways of achieving this is by mark recovery experiments. It is recommended that these experiments should be intensified and extended to as many centres as possible on all the exploited species.

10. Although the operations of mechanised fishing boats have spread all along the coasts of India, no reliable information about the fishing grounds in which they operate are available. This data is necessary to chart out the fishing grounds in a systematic pattern and to prepare fishing maps, so that efficiency of operation could be ensured. This is complimentary to recommendation No. 4.

11. With the introduction of more and more mechanised fishing vessels into the capture fishery for prawns, certain clash of interest between inshore and offshore fishermen is taking place. In some places this has resulted in violence leading to the closure of fishing operations. It may, therefore, become necessary to delineate areas of operation of inshore and offshore fishermen. A proper delineation of this nature can be brought out only when detailed data of the seasonal, geographic and bathymetric distribution of the concerned species are available. Efforts may be made to obtain such detailed data from concerned centres.

12. Collection of fishery data from mechanised boats was rendered difficult due to the scattered nature of landing at different places in the same village. Construction of fishing harbours in different centres will not only help the fishing industry but also facilitate collection of fishery data. It would therefore be advisable to construct more fishing harbours.

13. In view of the very poor fishery of Machilipatnam area, this centre may be closed down.

14. A prawn research worker may be posted at Visakhapatnam to make observations on the prawn fishery of that region, where prawn fishing is fast developing.

15. Another centre may be opened between Sakthikulangara and Mayyanad to study the prawn resources of Ashtamudi Lake and the offshore prawn catches landed at Neendakara, an important landing centre having the maximum number of mechanised fishing boats.

16. The enhanced activities of exploitation of this natural resource, its processing, distribution and export are now being carried out in an unorganised manner. These activities do not find a place in the All India Fisheries Act of 1897. It is therefore necessary to have statutory laws and provisions to govern these activities. Such laws will not only enable us to manage the resources in the most beneficial manner but also help to improve the quality of the exported products.

17. Due to the inordinate demand of prawns in the world market and it being the most valuable of the exploited marine resources of the country, further development is bound to take place in the coming years. Side by side with these developments the research and exploratory programmes on the crustacean resources will have to be expanded and strengthened. All these research activities may be brought under an independant division of the C.M.F.R. Institute with a full fledged Head of Division.

II. SUMMARY

The All India Co-ordinated Research Project on 'Studies on marine prawn biology and resources' was initiated as a supplementary programme to augment the researches carried out at the Central Marine Fisheries Research Institute with the objective of making detailed assessment of the prawn resources of the country.

The prawn fishery of the country is chiefly supported by the penaeid prawns suitable in size for processing and export. These prawns account for about 55% of the total production. They are Penaeus indicus, P. merguiensis, P. monodon, P. semisulcatus, Metapenaeus dobsoni, M. affinis, M. monoceros, M. brevicornis and Parapenaeopsis stylifera. Enormous quantities of small sized non-penaeid prawns like Acetes indicus and Palaemon tenuipes are landed in Maharashtra region.

The marine fishery for prawns is generally confined to shallow coastal areas of less than 40 metres depth. Bulk of the catches are taken by small mechanised boats operating trawl nets and the indigenous small crafts using chiefly seine nets and gill nets. The trawl fishery season in the west coast extends from September to May, heaviest catches being landed in December to February. In the estuaries and backwaters also an assortment of devices are used in catching prawns.

India emerged as the premier prawn producing country of the world in 1972 and continued to be so in 1973 also, the total landings in these two years having been 1,63,849

and 2,03,893 tonnes respectively. About half the catches were penaeid prawns, of which the major portion came from Kerala regions. Almost the entire non-penaeid prawn catch was from Maharashtra region.

In Bombay the trawl catches accounted for 2100 tonnes in the two years. Versova, a major fishing village in the country, registered total landings of 1361 and 1278 tonnes of predominantly non-penaeid prawns in 1972 and 1973 respectively, caught by the indigenous "dol" nets. The project centres of Madh and Mahul in Bombay also showed a similar trend. Prawn landings in Goa and Karwar were comparatively poor. Mangalore had a sizeable prawn fishery, the trawler landings in the two years amounting to 3652 tonnes. The Calicut trawler fishery was much better in 1973 than in 1972 having been 636 tonnes as against 198 tonnes. Cochin recorded the highest trawl catches, viz. 2141 and 6014 tonnes in 1972 and 1973 respectively. The catch/hour of 28.2 kg in 1973 was much better than the 15.8 kg of 1972, showing the superior level of abundance in that year. This situation in the fishery could be forecast much earlier. The trawler landings at Ambalapuzha during February to May in 1972 were much better than those of the corresponding period in 1973. Tuticorin and Mandapam showed promise of a substantial trawl fishery. Trawler landings in Madras were insignificant. Kakinada had a lucrative offshore fishery accounting for 1688 tonnes in the two years.

Among the estuarine fisheries investigated, substantial landings were reported from Cochin backwaters and paddy fields (4208 tonnes), and from the estuarine system around Kakinada (1034 tonnes).

The catch rate of the main trawl fisheries of the west coast indicated that the level of abundance of the prawn resources was considerably high in the Quilon-Mangalore region.

Data from the Project centres have shown that the major penaeid species like P. indicus, M. dobsoni and P. stylifera grow at a faster rate than hitherto understood and that most of them do not live more than two years. Almost all the species breed throughout the year with two peak spawning periods. On both the coasts these prawns spawn intensively in Noverber-December. Mark recovery experiments have showed that the movement of the prawns is largely within the fishing ground itself.

Penaeid prawn catches were dominated by females in these years. Catches of species like M. dobsoni and P. stylifera were composed mostly of 7 to 12 months old prawns. The spawning population of these prawns consisted of 0-year class. The fishery of P. indicus was largely supported by one year olds. Most of the species have only a short fishable life span.

III. MAIN REPORT

REPORT OF THE PROJECT CO-ORDINATOR

1. REPORT PERIOD : AUGUST 1971 to FEBRUARY 1974

2. PROJECT TITLE : "STUDIES ON MARINE PRAWN BIOLOGY AND RESOURCES"

3. OBJECTIVES : To make an accurate assessment of the marine prawn resources of the country and to study factors such as age, growth, maturity, spawning, recruitment and characteristics of the population of the commercially important species of prawns.

4. STAFF POSITION IN THE CO-ORDINATOR'S CELL

Name of the sanctioned post (1)	Name of personnel (2)	Date of joining (3)	Recruitment position of vacant posts (4)
AT COCHIN			
Senior Fishery Scientist (Project Co-ordinator)	(Full time Co-ordinator was not appointed. The Director, Central Marine Fisheries Research Institute acted as Co-ordinator)		
Junior Fishery Scientist	P. Vedavyasa Rao	27-10-1971	

(1)	(2)	(3)	(4)
Senior Research Assistant	N. Surendranatha Kurup	1.3.1972	
Computor	A. Kanakkan	1.3.1972	
Senior Clerk	M. Ganapathy	16.2.1972	
Junior Stenographer	M.A. Seetha	10.12.1973	
Fieldman	-	Vacant with effect from 18.12.73	
Messenger	M.K. Abdulla	7.8.1971	
AT BOMBAY			
Junior Fishery Scientist	Smt.P.V. Kagwade	1.11.1971	
Fieldman	R.B. Bhangare	1.1.1973	
AT PANAJI (GOA)			
Junior Fishery Scientist	M.M. Kunju	4.8.1971	
Senior Research Assistant	P.A. Thomas	23.8.1971	
Fieldman	G.M. Korar	1.8.1973	
AT MADRAS			
Junior Fishery Scientist	M.S. Muthu	29.10.1971	
Fieldman	A. Kathavarayan	1.5.1971	
AT COLACHEL			
Senior Research Assistant	C. Suseelan	30.7.1971	
AT CUDDALORE			
Senior Research Assistant	V. Thangaraj Subramanian	2.9.1971	
AT MACHILIPATNAM			
Senior Research Assistant	D.B. James	12.8.1971	
AT PURI			
Senior Research Assistant	K.N. Rajan	12.8.1971	

5. TOTAL SANCTIONED GRANT (YEAR-WISE)

Year	Total	Recurring/ Non-recurring
1971-72	42,058.00	-
1972-73	2,00,000.00	-
1973-74	1,55,000.00	-

6. TOTAL AMOUNT SPENT (YEAR-WISE)

Year	Total	Recurring	Non-recurring
1971-72	42,058.00	-	-
1972-73	1,47,873.15	1,36,214.62	11,658.53
1973-74	1,53,466.27	1,34,898.70	18,567.57

7. PROJECT LOCATIONS:

i) Central Marine Fisheries Research Institute, K.C. Avenue, P.B.No.1912, Cochin-18.

ii) Central Marine Fisheries Research Sub-station, Botawalla Chambers, Sir P.M. Road, Bombay-1.

iii) Central Marine Fisheries Research Centre, 'Daulat', St. Inez, Panaji, Goa.

iv) Central Marine Fisheries Research Sub-Station, Red Bungalow, Commander-in-chief Road, Madras-8.

v) Field Centre of Central Marine Fisheries Research Institute, Beach Road, Colachel.

vi) Field Centre of Central Marine Fisheries Research Institute, Cuddalore, Tamil Nadu.

vii) Field Centre of Central Marine Fisheries Research Institute, Subba Rao Road, Machilipatnam, A.P.

viii) Field Centre of Central Marine Fisheries Research Institute, c/o State Fisheries Department, Puri, Orissa.

8. INTRODUCTION : One of the important developments that has taken place in recent years in the annals of the marine fisheries of India has been the rapid expansion of the prawn fishery and its congnate industries. The discovery of the existence of a rich prawn belt rather close to the coast, which could be exploited by small mechanised crafts, was the first notable event in this direction. Introduction of small mechanised crafts followed in large numbers year after year, leading to a steady rise in the catches of prawns. The prawn fishery received a sudden impetus on account of the demand for Indian prawns in the foreign markets. The demand soon exceeded the supply. Today, the country with an estimated catch of 2.04 lakh tonnes of prawns in 1973, has emerged as the leading nation in the world in regard to the prawn landings. With the organisation and establishment of an efficient sea food industry, the country has also become one of the foremost nations

exporting processed prawns and prawn products to a large number of countries all over the world. The increasing trend in the crustacean landings was reflected in the quantity of prawn and lobsters exported from the country during the years 1972 and 1973 which amounted to 32,117 and 38,761 tonnes respectively valued at Rs.55 and 73 crores.

The development of the prawn fishery was helped considerably by the scientific investigations carried out by the Central Marine Fisheries Research Institute during the past 25 years. Although these investigations have contributed significantly to the understanding of the prawn resources, the extremely complex nature of the dynamics of the stocks necessitated the expansion of the investigations to areas from where no information was so far available. In the capture fishery for prawns, marked seasonal and annual fluctuations in the yield have been a usual feature, but a realistic assessment of the cause of these fluctuations, has not been made. Moreover, increased fishing effort in some of the areas of the coast has created new problems. In certain parts of the southwest coast, the harvest of prawns from the known grounds has reached the point of diminishing return. In other areas also the fishery is developing at a very fast rate and a situation similar to that prevailing in the southwest coast is likely to be reached soon. Reliable scientific informations on the exploited prawn population, effects of the continued exploitation, the rate of self generation of stocks, and over all picture of the resources - their distribution, abundance, fluctuations and causes thereto -

and the life-history of the component species are essential for evolving rational measures of development. In view of the importance for continued expansion of the fishery and for improving the status of the country in the sphere of international trade in prawns and shrimps, the need for an All India Co-ordinated Research Project for Studies on Marine Prawn Biology and Resources was felt, and accordingly, it was sponsored by the Indian Council of Agricultural Research. The Project was initiated late in 1971 with the main objective of assessing the marine prawn resources of the country and to study the biology of the important commercial species of prawns.

9. SOURCES OF DATA AND OUTLINE OF THE PLAN OF WORK : This report embodies mainly the results of the investigations carried out in 1972 and 1973 based on the data collected from the centres selected for expanded investigations under the Project. In order to make the report broad based and more informative relevant data from the reports of the Crustacean Section of the Central Marine Fisheries Research Institute are also incorporated in this report.

After gathering the background information on the prawn fisheries of the regions in which the Project centres were located, two observation centres were fixed for the collection of samples for biological studies and regular data on catch statistics. Wherever possible one estuarine observation centre was selected, since almost all the penaeid prawns

have their nursery grounds in the estuaries. Juvenile abundance in the nursery areas would indicate the success of the fishery in the ensuing season and therefore the estuarine phase of the prawn needs equal investigation. Investigation centres are shown in Fig. 1. To estimate the monthly species-wise catch, the average weight of catch per gear unit on an observation day was multiplied by the number of each units in operation on that day and the total for all the observation days was then obtained and raised to the total number of actual fishing days in that particular month to get the monthly weight. The total fishing effort (expressed in terms of actual fishing hours or fishing units) for gear was estimated similarly.

Prawn samples from each gear were analysed for sex, weight, number, total length and maturity stages of females. The number landed was estimated from the weight of catch by the following method. The length measurements were grouped in appropriate size intervals, and the number of prawns in each size group was estimated by using sample weight and the estimated total catch of the species for the day. These data were then raised to the monthly catch weight to get the number of prawns landed during the particular month. The outline of the plan of work as envisaged in the first workshop in 1972 is given in Appendix I.

The growth of prawns was mainly studied by following the progression of modal size in the monthly length frequency distribution of the species concerned. Details of the tags and method of tagging used in the mark recovery experiments are given elsewhere.

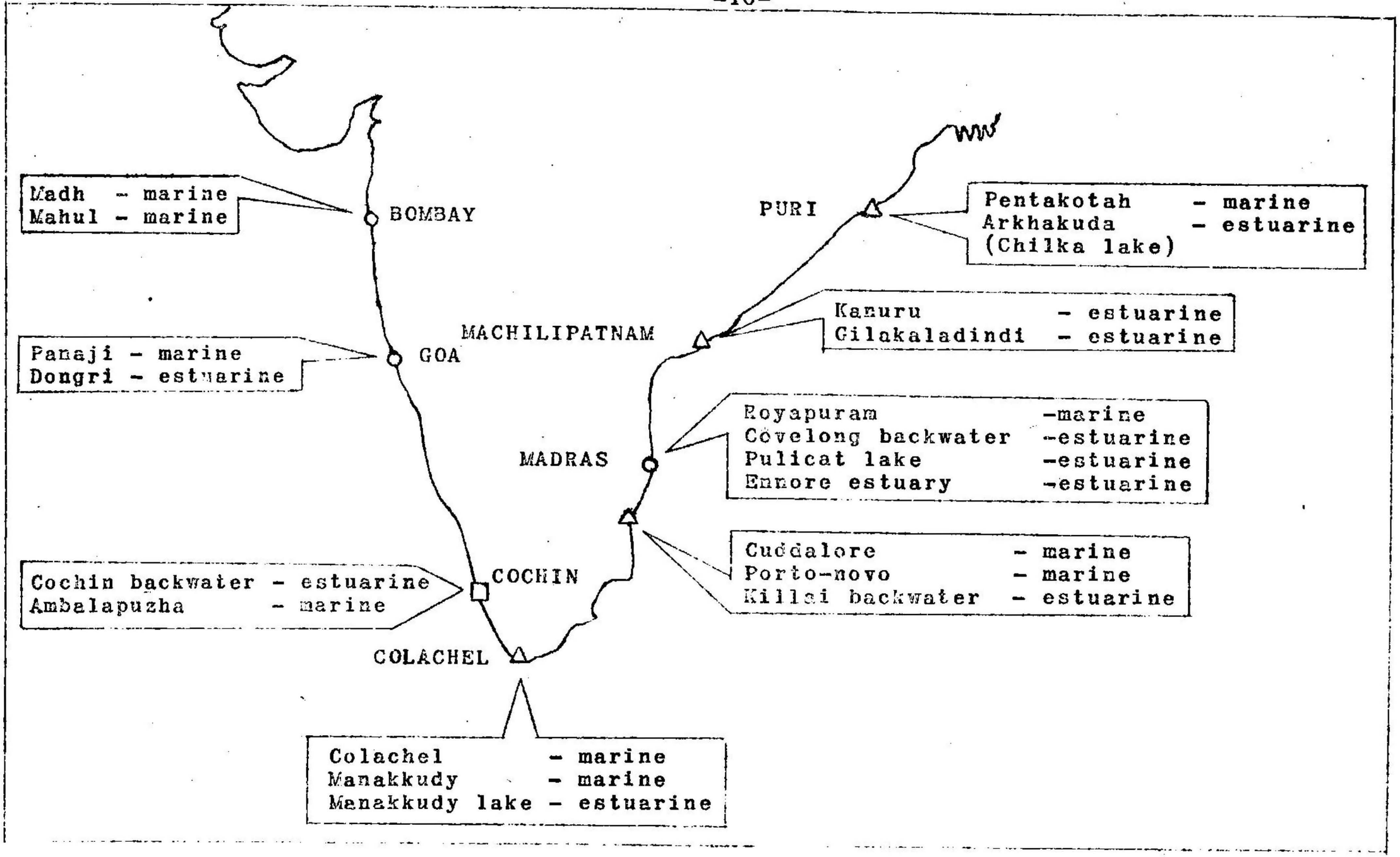

Fig. 1. Map showing the location of prawn research centres under the Co-ordinated Research Project

□ Main Co-ordinating Centre, ○ Sub-centre, △ Collection centre

10. RESOURCES AND THEIR EXPLOITATION

10.1 Commercial species of prawns and their distribution

The prawn fishery of India is chiefly supported by the species belonging to the families Penaeidae, Palaemonidae and Sergestidae of the order Decapoda; suborder Natantia. Penaeid prawns are in greater demand for the export trade than the non-penaeid prawns. In the total crustacean landings of the country, penaeid prawns account for over 55%, the major portion of which is frozen and exported.

The species composition of the prawn catches at different centres is given in Table I.

At Bombay the prawn fishery is comprised chiefly of the non-penaeids like A. indicus and P. tenuipes. The penaeids of importance are M. affinis, M. brevicornis, P. stylifera, P. sculptilis, P. hardwickii and S. indica. The commercial prawn fishery in the marine region from south of Goa to Kerala coast is mainly supported by smaller species like M. dobsoni and P. stylifera, while on the extreme south-west coast and on the east coast it is chiefly contributed by the species belonging to the genus Penaeus. However, off Machilipatnam, M. brevirornis and M. dobsoni are found in abundance.

In respect of the species composition, the estuarine fishery of Goa and Machilipatnam is similar and is constituted by the juveniles of M. monoceros and M. dobsoni. But, at Madras and Manakkudy (Colachel) P. indicus forms the bulk of the catch, as in the case of marine fisheries of those regions.

TABLE I

Species composition of the prawn catches at different centres

Centre	Region	Commercial species
Bombay	Marine	Acetes indicus, Palaemon tenuipes, Solenocera indica, Parapenaeopsis sculptilis, P. hardwickii, P. stylifera, Hippolysmata ensirostris, Metapenaeus brevicornis, M. monoceros, M. affinis, Atypopenaeus stenodactylus.
Goa	Marine	Metapenaeus dobsoni, P. stylifera, M. affinis, Penaeus merguiensis.
	Estuarine	M. dobsoni, M. monoceros.
Ambalapuzha	Marine	M. dobsoni, P. stylifera, Penaeus indicus.
Colachel	Marine	P. indicus, P. monodon, P. semisulcatus, M. dobsoni, M. monoceros, P. stylifera, A. indicus.
	Estuarine	P. indicus, P. monodon, M. dobsoni, M. monoceros.
Cuddalore	Marine	P. indicus, M. monoceros, M. dobsoni, P. monodon, P. semisulcatus.
	Estuarine	P. indicus, M. monoceros, M. dobsoni.
Madras	Marine	P. indicus, M. monoceros, M. dobsoni.
	Estuarine	P. indicus, M. monoceros, P. monodon.
Machilipatnam	Marine	M. brevicornis, M. dobsoni, P. monodon.
	Estuarine	M. monoceros, M. dobsoni.
Puri	Marine	P. merguiensis, P. indicus, P. monodon, M. affinis.
	Estuarine	P. indicus, P. monodon, M. monoceros, M. dobsoni.

10.2 Fishing areas and grounds

Prawn fishery in Bombay area is confined to inshore waters up to 40 metres. At Madh the nets are operated at a distance of about 32 km whereas at Mahul the fishery is confined to a distance of about 13 kms from shore.

The prawn fishing along the Goa coast is confined to the narrow coastal belt of 5 kms from the shore and to a depth zone between 6 and 20 metres. The areas between Calangute and Marmagoa Harbour appears to be the most productive ground.

At Ambalapuzha, the prawn fishery is carried cut throughout the year. Fishing by trawl-net is usually conducted in the depth range of 10 to 40 metres, where the bottom is muddy. During the monsoon months, fishing is confined to near shore waters and the indigenous crafts and gears are employed for fishing. When the trawl fishery commences after the rainy season, the fishing is carried out for a brief period in the northwest grounds and then in the southwest grounds at 14 to 30 metres depth zone. As the season advances, the fishing is shifted again to slightly deeper grounds (20-35 metres) in the northwest. Just before the commencement of the rainy season (April-May), the trawlers generally operate at 10 to 25 metres depth.

In Kanyakumari District, the Manakkudy lake with an area of 370 acres forms an important nursery ground for the marine prawns of that area. Throughout the monsoon months (June-August and October-December) the lake is connected with sea, and in other months it remains generally landlocked. The average depth of the lake is about 3 metres and the bottom ground is muddy with dense admixture of

fossilised lime shell. The salinity and temperature of the lake ranges between 0.73 °/$_{oo}$ and 25.3 °/$_{oo}$ and 22.4 °C and 31.9 °C respectively. Wide fluctuations in salinity has been observed during the monsoon months when the lowest as well as the highest values are recorded. Relatively high temperature is observed during March-May. The inshore fishing of this area is carried out in the depth zone of 4-20 metres where the bottor is sandy and rocky with unevenly distributed coral patches in the deeper regions.

The marine prawn fishing area of Cuddalore and Porto Novo stretches along the coast from 15 km north of Cuddalore to about 15 km south of Porto Novo and 10 to 15 km seaward from the shore. The fishing ground south of Porto Novo is muddy and sandy.

In the Madras region, the prawn fishing ground extends from Pulicat in the north to Mahabalipuram in the south. The fishing is mostly done in 10 to 45 metres depth where the bottom is muddy and sandy.

In the estuarine systen of Machilipatnam, prawn fishing is conducted at three main areas - in the north of the main river Krishna, in the estuary of the branch of Krishna river near Hamsaladevi - Palakayatippa village complex, and in the mouth of the river Upputeru. Recently a trawler has been in operation in the inshore fishing grounds off Antarvedi near Machilipatnam and fairly good catches of prawns have been reported.

In Chilka lake, fishing for prawns is mainly carried out at a depth of 2 to 3 metres. In the marine region the fishing grounds extend upto 10 km from the shore, but the fishing operations are conducted at a depth of 15 to 50 metres.

10.3 Fishing seasons and crafts & gears employed in the fishery

The important fishing seasons and the main crafts and gears employed at different centres of the Project are given in Table II.

10.4 Depth-wise distributions of prawns in the Project centres

In Bombay the data collected are not suitable to determine the depthwise distribution of prawns.

In the Goa region, bulk of the prawn catches are obtained from 6 to 20 metres depth zone. M. dobsoni is generally abundant in lesser depth, while M. affinis is caught from the deeper zone. During January and February, large specimens of M. monoceros are obtained along with M. affinis at 15 to 20 metres depth. At Ambalapuzha, prawns are generally caught from 10 to 40 metres by trawl net. During the beginning of the season prawns are seen to concentrate at 14 to 30 metres depth zone, and as the season advances, they move to slightly deeper areas (20 to 35 metres). However, at the end of the season, they again colonise the shallower grounds. At Madras also prawns are caught from 10 to 45 metres depth. The results of the operation of a trawler off Machilipatnam have revealed that M. dobsoni and M. brevicornis are distributed in fairly dense concentration at a depth range of 15 to 20 metres in the inshore fishing grounds. In the same area, a few large specimens of P. monodon are also encountered.

TABLE II

Fishing season and the crafts and gears employed in the prawn fishery at different centres under the Project

Centre	Fishing region	Fishing season	Crafts	Gears
Bombay	Inshore	September to May	Mechanised and non-mechanised country craft	Bag net(Dol)
Goa	Offshore	October to April	Mechanised boats	Trawl
	Inshore		Non-mechanised boats	Shore seine & gill net
	Estuarine	Throughout the year	Non-mechanised boats	Stake net & gill net
Ambala-puzha	Offshore	October to May	Mechanised boat (10 to 40 h.p.)	Shrimp trawl
	Inshore	June to September	Non-mechanised boat	Boat seine
Colachel	Inshore	February to October	Catamaran	Bottom set gill net, boat seine
	Estuarine	Throughout the year	Catamaran	Cast net, drag net, boat seine
Cuddalore	Offshore	Throughout the year	Mechanised boat (27 to 54 h.p.)	Trawl net
	Estuarine	Throughout the year	Catamaran	Stake net, cast net, gill net
Madras	Offshore	Throughout the year	Mechanised boat (30 to 50 h.p.)	Trawl net
	Estuarine	Throughout the year	Rafts	Cast net, drag net
Machili-patnam	Estuarine	Throughout the year	Non-mechanised boat	Stake net, drag net, cast net, shore seine
Puri	Estuarine	April to August	Non-mechanised Boat	Drag net, Bomboo traps
	Inshore	October to February	Catamaran, non-mechanised boat	Gill net

10.5 Landings

10.5.1 All India landings

India emerged as the major prawn producing country of the world in 1972 and 1973. The total landings of marine prawns in these two years were 1,63,849 and 2,03,893 tonnes respectively. State-wise landings of penaeid and non-penaeid prawns in these two years are given in Table III.

TABLE III

State-wise landings of marine prawns in 1972 and 1973 in tonnes

States	1972		1973	
	Penaeid	Non-penaeid	Penaeid	Non-penaeid
West Bengal & Orissa	1471	...	2565	486
Andhra Pradesh	5145	437	8170	669
Tamil Nadu	4885	148	4504	1285
Pondicherry	177	5	33	8
Kerala	35866	711	85064	981
Karnataka	8058	17	8235	1
Goa	561	...	785	...
Maharashtra	20173	83952	17024	63455
Gujarat	2013	218	10550	70
Andamans	12	...	8	...
Laccadives	...	...	...	...
TOTAL	78361	85488	1,36,938	66955

The status of the country in prawn production is mainly due to the enormous landings of non-penaeid prawns in Maharashtra.

The prawn landings of 1972 in Maharashtra were quite unusual, when 100% increase in the penaeid prawns and 12% increase in non-penaeid prawns was recorded over those of 1971. The increase in the All India landings of 1972 was brought out mainly by this State. In Kerala, while the penaeid prawns showed an increase of 6.7%, the non-penaeid prawns declined by about 45%, over those of 1971. Except for marginal decline seen in Pondicherry, Karnataka and Maharashtra all other States recorded increased landings of penaeid prawns in 1973. In the case of non-penaeid prawns a considerable decrease in landings was noticed in Maharashtra in 1973.

The mechanised vessels operating trawl nets on the west coast were active almost throughout the year except monsoon months. In 1972 there was a general increase in the fishing activity on the east coast mainly brought about by the commencement of operations of some of the fishing companies and this trend continued in 1973 also. A significant development that took place in the capture fishery for prawns is the widespread introduction of bottom-set gill-nets made of synthetic twince for large sized prawns, particularly in the southern States and in the east coast. In 1973 mechanised fishing boats have started operations in areas hitherto considered not suitable for trawling. The Tinnelvely coast is one of the areas where the impact of these developments has shown definite results.

The monsoon prawn fishery from the mud-banks of south-west coast of India was relatively poor in 1972 and lasted only for a brief period at Ambalapuzha and Azhicode-Nattika areas. This fishery was slightly better in 1973.

10.5.2 Landings at different Project Centres

The estimated monthly prawn landings and catch-per-unit of effort at different project centres on the west and east coasts during 1972 and 1973 are given in Table IV and V. The annual catch data of 1973 showed that overall prawn fishery on the west coast was considerably better than that of the previous year.

In the Bombay Centres prawn catch in 1972 was much better than in 1973. The catch was good almost throughout 1972 but in the following year it was so only between February and May and also in November. In Goa, better yields of prawns were generally obtained during November-February/March. At Ambalapuzha, although the prawn landings by trawl nets during February-May 1972 were relatively higher, the fishery was poor in the corresponding period of 1973. However, the mud-bank fishery of 1973 was successful as compared to that of 1972. At Colachel area, the fishing season of 1972 commenced in May and lasted upto November while in 1973, the fishery existed up to October only with comparatively higher catches.

The offshore prawn fishery of Cuddalore-Porto Novo region generally exhibited two peak seasons during December-January and June-July. The highest catch as well as catch-per-unit of effort was recorded in January 1973 at Cuddalore and in July 1973 at Porto Novo.

TABLE IV

Estimated monthly prawn landings (in tonnes) at the Project Centres on the west coast during 1972 - 73 (Data given within the brackets pertains to catch/unit of effort in kgs)

	BOMBAY		GOA	
	Inshore (Madh)	Inshore (Mahul)	Offshore	Estuarine
1972				
January	541.3 (14.2)	3.7 (1.2)	162.9 (50.2)*	-
February	254.2 (9.6)	14.9 (5.4)	24.4 (31.1)	-
March	238.2 (7.7)	8.6 (4.0)	10.6 (17.8)	-
April	635.8 (11.3)	2.2 (0.9)	12.7 (12.4)	0.3 (5.0)
May	649.2 (16.5)	9.3 (2.0)	14.3 (21.0)	0.5 (4.7)
June	147.8 (13.0)	3.9 (1.2)	5.2 (23.0)	0.01(3.0)
July	-	-	-	-
August	-	-	-	-
September	246.1 (38.6)	-	0.4 (4.2)	-
October	409.9 (16.0)	12.7 (6.1)	8.7 (24.8)	0.5(22.0)
November	512.6 (14.5)	2.3 (1.1)	73.4 (35.6)	0.3(23.0)
December	155.4 (6.2)	11.1 (3.2)	99.8 (30.4)	0.3(21.6)
1973				
January	74.7 (2.6)	3.6 (1.8)	103.1 (28.9)	0.4(40.0)
February	324.2 (11.5)	13.3 (5.4)	113.9 (30.6)	0.3(34.0)
March	661.1 (14.6)	5.2 (3.3)	77.6 (19.0)	0.1(10.0)
April	449.7 (14.1)	3.5 (1.2)	36.5 (9.8)	0.2(15.8)
May	261.1 (10.8)	5.0 (1.9)	39.8 (12.2)	0.5(23.0)
June	75.6 (13.4)	5.2 (1.9)	3.6 (9.6)	0.09(16.0)
July	-	-	-	0.01 (2.4)
August	-	-	-	0.03(4.0)
September	-	-	-	0.09(6.0)
October	-	3.8 (3.5)	3.2 (12.6)	0.5(42.0)
November	210.2 (6.1)	8.3 (4.0)	52.2 (17.8)	0.4(57.0)
December	159.0 (4.8)	19.8 (7.2)	65.3 (18.4)	0.06(7.0)

*Catch-per-unit of effort per unit.

TABLE IV Contd.

	COCHIN(AMBALAPUZHA)		COLACHEL		
	Offshore	Inshore	Inshore (Colachel)	Inshore (Manakkudy)	Estuarine (Manakkudy)
1972					
January	48.9(1.8)	-	-	-	-
February	185.4(10.3)	-	-	0.2(0.1)	0.3(0.2)
March	358.3(10.4)	-	-	0.6(0.08)	1.4(0.5)
April	434.8(11.5)	-	-	0.01(0.02)	0.5(0.2)
May	498.4(16.3)	-	3.2(0.2)	0.7(0.12)	0.4(0.2)
June	-	-	4.4(0.2)	1.3(0.15)	0.1(0.1)
July	-	1170.0(18.6)	0.2(0.1)	0.04(0.04)	0.2(0.2)
August	-	1.0(0.2)	16.0(0.9)	2.0(0.4)	0.1(0.3)
September	-	15.9(2.3)	6.9(0.4)	0.01(0.2)	0.05(0.1)
October	115.3(6.6)	-	-	-	0.01(0.2)
November	265.7(9.9)	-	0.6(0.06)	0.8(0.12)	-
December	243.3(8.8)	-	-	-	-
1973					
January	4.5(1.4)	-	-	-	-
February	44.1(3.2)	-	-	0.1(0.03)	1.3(0.9)
March	36.5(3.5)	-	-	0.01(0.02)	0.3(0.3)
April	4.5(1.4)	-	-	0.1(0.02)	0.1(0.2)
May	98.1(6.5)	-	0.6(0.1)	0.04(0.01)	0.8(0.4)
June	-	23.1(2.5)	9.3(0.2)	9.7(0.5)	1.0(0.5)
July	-	4230.6(30.6)	75.4(2.7)	0.9(0.1)	0.5(0.4)
August	-	32.6(1.9)	1.2(0.09)	7.0(0.4)	0.07(0.1)
September	-	-	0.9(0.06)	0.6(0.06)	0.08(0.5)
October	-	13.8(2.3)	-	0.1(0.04)	0.4(0.6)
November	146.5(7.9)	-	-	-	0.03(0.1)
December	158.8(4.6)	-	-	-	0.02(0.1)

TABLE V

Estimated monthly prawn landings (in tonnes) at the Project centres on east coast during 1972-73

(Data given within the brackets pertains to catch/ unit of effort in kg)

	CUDDALORE	PORTONOVO		MADRAS	
	Offshore	Offshore	Estuary	Offshore	Estuary
1972					
January	-	-	-	19.8(2.61)	1.4(1.62)
February	-	-	-	13.2(2.24)	1.5(1.75)
March	-	-	-	8.5(3.24)	0.9(1.1)
April	8.7(2.3)	9.0(2.2)	-	6.7(1.94)	0.5(1.03)
May	15.4(3.0)	21.9(3.9)	-	11.9(1.87)	0.3(0.38)
June	18.7(4.6)	20.4(4.0)	-	9.9(1.36)	0.8(0.71)
July	25.4(3.8)	31.7(5.2)	6.8(4.4)	7.5(1.0)	0.5(0.91)
August	4.9(2.7)	5.5(2.9)	5.6(4.3)	7.2(0.33)	0.9(1.4)
September	9.9(4.5)	3.5(3.1)	2.5(3.0)	63.4(5.37)	1.2(1.05)
October	10.8(2.1)	4.4(1.7)	0.3(0.9)	9.0(1.79)	0.7(0.86)
November	6.3(1.6)	4.8(1.6)	2.9(3.5)	7.7(1.39)	0.03(0.15)
December	34.1(5.5)	13.1(13.0)	2.5(3.9)	11.1(1.71)	1.8(1.96)
1973					
January	48.9(5.8)	34.8(6.4)	9.0(6.1)	8.7(1.59)	0.5(1.13)
February	13.8(4.2)	31.2(7.6)	0.5(1.4)	16.4(3.52)	0.3(1.14)
March	3.5(1.6)	16.0(4.5)	1.7(2.3)	6.3(1.30)	0.09(1.0)
April	12.5(3.7)	24.2(4.4)	3.3(3.1)	6.9(1.31)	0.2(1.17)
May	12.4(3.4)	26.2(3.8)	0.9(2.3)	8.5(1.76)	0.8(1.1)
June	13.6(4.6)	38.7(7.5)	1.2(2.5)	8.5(1.73)	1.9(1.76)
July	15.0(4.5)	88.5(13.3)	3.0(3.5)	22.1(3.36)	1.8(1.78)
August	15.0(5.8)	76.2(12.5)	7.8(5.2)	8.9(1.32)	2.8(2.25)
September	14.4(5.1)	13.8(3.9)	3.5(3.0)	25.9(3.36)	1.9(1.89)
October	17.8(4.6)	18.8(3.6)	0.6(1.8)	24.1(4.29)	2.3(2.0)
November	30.6(4.12)	19.9(4.7)	1.4(1.5)	33.6(4.75)	0.6(1.19)
December	40.3(5.5)	5.5 (4.3)	8.8(6.0)	19.6(2.85)	0.3(1.03)

TABLE V Contd.

	MACHILIPATNAM		PURI	
	Estuary (Kanuru)	Estuary (Gilakaladinde)	Inshore	Estuary
1972				
January	-	-	24.5(0.2)	-
February	-	-	1.4 (0.07)	-
March	-	-	8.1 (0.3)	-
April	-	-	-	-
May	1.4 (0.25)	1.2 (0.35)	-	1.4 (0.6)
June	1.4 (0.35)	1.0 (0.47)	0.2 (0.03)	1.5(0.7)
July	2.0 (0.47)	2.0 (0.37)	0.2 (0.03)	2.2 (1.05)
August	1.5 (0.37)	1.5 (0.40)	0.1 (0.01)	0.7 (0.4)
September	2.4 (0.42)	1.8 (0.67)	0.3 (0.04)	0.1 (0.5)
October	2.3 (0.72)	3.2 (0.95)	11.3 (0.3)	0.01(0.1)
November	4.3 (0.72)	3.7 (0.57)	34.4 (0.4)	0.01(0.1)
December	2.4 (0.82)	2.0 (0.42)	37.9 (0.4)	0.02(0.1)
1973				
January	1.6 (0.65)	2.3 (0.67)	6.4 (0.1)	0.01(0.2)
February	1.7 (0.65)	2.1 (0.55)	1.0 (0.06)	0.02(0.2)
March	2.6 (0.72)	2.0 (0.52)	0.7(0.04)	-
April	2.1 (0.65)	2.2 (0.60)	-	0.1 (0.3)
May	1.9 (0.72)	3.0 (0.67)	-	-
June	3.6 (0.67)	3.2 (0.62)	-	-
July	2.4 (0.62)	2.5 (0.70)	0.1 (-)	4.6 (1.4)
August	2.1 (0.67)	2.7 (0.67)	0.9 (0.06)	0.8 (0.6)
September	3.0 (0.70)	2.8 (0.70)	1.9 (0.1)	0.2 (0.3)
October	3.6 (0.72)	3.0 (0.70)	4.9 (0.1)	0.06(0.2)
November	4.7 (1.0)	4.3 (1.0)	8.7 (0.6)	0.08(0.3)
December	6.5 (1.2)	5.8 (1.2)	111.1 (0.7)	0.04(0.8)

There is no definite prawn fishing season at Madras. Moreover, the catch per fishing hour for prawns was relatively low during April-August 1972 and March-June 1973. P. indicus contributed the bulk of the catch in both the year, 1972 and 1973, forming nearly 71% and 55% respectively. In the estuarine fishery P. indicus contributed to the bulk of the catch in 1972 (56%) and in 1973 M. monoceros formed the greater percentage (48%). The catch/trawling hour for P. indicus declined slightly from 1.62 kg/hr in 1972 to 1.56 kg/hr in 1973. But the number of prawns per trawling hour in 1972 was only 39 whereas it was 59 in 1973 indicating no decline in the abundance of P. indicus during 1973.

The average monthly catch of prawns derived from stake nets at observation centre at Machilipatnam was about 2 tonnes. It has been estimated that the entire estuarine system of the area produces annually about 970 tonnes of prawns. As in the other centres, the major portion of the prawn catches from the inshore waters of Puri are landed during October-December. In 1973, the fishery of October and November was a failure, but in December it was exceptionally good, producing a record catch of 111 tonnes during that month alone. In the Chilka lake, highest catches are generally observed in July.

The catches of major species constituting the prawn landings at different centres are given in Tables VI to IX.

The most important species contributing the prawn fishery in Bombay are A. indicus and P. tenuipes; the two together forming about 65 to 75% of the catches in two years. These two, though available throughout the year, were essentially premonsoon species and were inversely related to

TABLE VII

Estimated monthly landings (in kgs) of major species of prawns contributing to the estuarine fishery at Project centres on the west coast during 1972-73.

MONTHS	GOA (Dongri)				COLACHEL (Manakkudy)			
	P. indicus	P. monodon	M. dobsoni	M. monoceros	P. indicus	P. monodon	M. dobsoni	M. monoceros
1972								
January	-	-	-	-	-	-	-	-
February	-	-	-	-	179	48	53	25
March	-	-	-	-	1202	55	157	17
April	80	100	20	100	339	162	11	8
May	240	194	40	41	294	19	10	39
June	6	2	-	4	105	4	-	3
July	-	-	-	-	179	8	21	9
August	-	-	-	-	129	10	11	3
September	-	-	-	-	26	6	16	5
October	-	-	108	420	11	3	2	1
November	-	-	145	160	-	-	-	-
December	10	-	255	60	-	-	-	-
1973								
January	50	-	200	150	-	-	-	-
February	10	-	210	110	1262	3	56	-
March	-	-	85	10	359	12	11	-
April	-	-	97	30	172	-	1	-
May	-	-	168	200	745	13	29	-
June	-	-	60	36	1006	-	28	-
July	-	-	8	4	472	-	7	-
August	-	-	10	18	77	-	-	-
September	-	-	28	58	61	-	26	1
October	-	-	216	288	298	14	67	1
November	-	-	280	132	21	3	11	1
December	-	-	16	40	23	-	1	-

TABLE VIII

Estimated monthly landings (in tonnes) of major species of prawns contributing to the marine fishery at Project centres on the east coast during 1972-1973

MONTH	CUDDALORE-PORTONOVO					MADRAS (Royapuram)			PURI (Pentakotah)			
	P. indicus	P. monodon	P. semisulcatus	M. monoceros	M. dobsoni	M. dobsoni	M. monoceros	P. indicus	P. merguiensis	P. indicus	P. monodon	M. affinis
1972												
January	-	-	-	-	-	8.5	2.0	7.5	9.1	6.1	2.0	7.7
February	-	-	-	-	-	5.1	1.4	7.7	-	-	-	1.4
March	-	-	-	-	-	2.3	-	6.0	-	-	-	8.1
April	2.58	2.5	-	6.7	4.1	1.4	9.1	4.3	-	-	-	-
May	8.0	6.1	-	14.6	6.8	1.03	3.7	7.0	-	-	-	-
June	11.2	6.1	0.2	10.7	7.4	0.75	0.01	7.3	0.09	-	-	0.1
July	17.0	4.3	8.7	16.7	3.0	1.3	1.9	1.8	0.1	-	0.02	0.02
August	2.3	0.6	0.9	3.2	1.9	-	4.4	0.3	0.07	0.01	0.02	0.01
September	3.3	0.2	0.3	0.4	9.3	-	-	63.4	0.1	0.09	0.01	0.04
October	2.0	0.3	6.4	5.8	0.7	0.2	-	4.6	8.6	1.6	0.5	0.4
November	0.7	0.2	1.4	7.1	0.3	0.7	-	4.5	320.5	8.8	3.6	1.3
December	34.7	0.7	0.4	9.2	1.0	0.04	0.5	10.5	20.1	11.8	4.6	1.4
1973												
January	60.6	1.9	-	4.6	2.0	0.3	0.4	7.6	2.7	2.6	0.2	0.8
February	16.6	2.1	-	4.7	13.9	0.7	0.6	13.1	0.2	0.2	0.03	0.5
March	1.7	1.3	-	7.4	6.5	0.3	-	4.9	0.3	0.1	-	0.2
April	9.0	1.4	0.1	9.7	9.1	0.8	0.02	5.2	-	-	-	-
May	16.6	1.2	0.4	10.7	4.2	0.4	0.6	4.9	-	-	-	-
June	18.5	0.6	0.1	19.7	2.6	1.8	0.4	3.1	-	-	-	-
July	33.3	1.4	0.3	39.6	24.9	3.7	1.5	12.5	0.1	-	-	-
August	24.3	0.7	2.3	26.9	33.5	2.4	1.1	3.6	0.4	0.4	-	-
September	9.2	0.3	2.1	3.6	7.6	2.9	0.4	16.8	1.1	0.8	-	-
October	4.8	-	10.7	7.5	8.6	13.5	0.8	6.1	3.3	1.2	0.2	0.1
November	18.4	0.3	4.2	8.1	16.7	14.3	1.03	13.0	46.3	56.7	1.5	0.6
December	28.9	0.5	-	-	0.9	5.3	0.05	13.5	56.2	77.9	2.5	1.4

TABLE IX

Estimated monthly landings (in kg) of major species of prawns contributing to the estuarine fishery at Project Centres on the east coast during 1972-73.

MONTHS	CUDDALORE (Killai backwaters)				MADRAS (Covelong)			
	P. indicus	P. monodon	M. dobsoni	M. monoceros	P. indicus	P. monodon	M. monoceros	M. dobsoni
1972								
January	-	-	-	-	953	217	68	23
February	-	-	-	-	1160	333	29	-
March	-	-	-	-	736	62	39	16
April	-	-	-	-	187	45	285	22
May	-	-	-	-	155	31	77	12
June	-	-	-	-	322	63	287	28
July	3685	480	161	2228	205	55	209	35
August	2340	287	934	1900	367	33	515	43
September	862	-	960	667	660	60	284	256
October	188	-	10	129	483	28	168	51
November	1999	165	409	328	27	-	-	-
December	1040	180	820	500	750	455	532	41
1973								
January	4743	387	546	3255	106	169	180	54
February	87	109	47	231	196	10	73	20
March	1023	229	47	397	71	-	16	3
April	1687	44	769	750	108	-	45	57
May	257	6	608	80	326	-	297	92
June	322	4	596	252	760	1	590	248
July	1070	69	810	976	718	-	646	150
August	3080	178	602	3697	532	-	1922	336
September	1791	-	481	1260	366	-	1278	268
October	155	3	126	290	820	-	1194	235
November	251	168	675	330	313	66	109	179
December	3212	411	1369	3828	180	2	164	14

TABLE IX Contd.

	MACHILIPATNAM				PURI (Arkhaknda)			
	Kanuru		Gilakaladinde					
	M. monoceros	M. dobsoni	M. monoceros	M. dobsoni	P. indicus	P. monodon	M. monoceros	M. dobsoni
1972								
January	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	849	250	904	162	874	503	28	20
June	1192	236	622	275	948	492	55	35
July	472	739	711	752	1288	848	84	27
August	541	773	702	546	452	195	22	27
September	855	1026	739	757	105	60	-	-
October	1283	504	1854	479	9	5	-	3
November	2730	810	2282	786	8	2	-	1
December	1725	263	1219	308	14	5	-	3
1973								
January	929	309	1209	524	10	4	-	-
February	776	189	905	646	17	9	3	-
March	559	1598	481	1003	-	-	-	-
April	1417	380	1446	526	83	60	7	7
May	1171	460	2357	533	-	-	-	-
June	3100	252	2232	855	-	-	-	-
July	562	879	892	943	2697	1600	186	118
August	824	909	1043	1123	426	341	23	23
September	1792	865	1499	820	108	60	-	-
October	2838	368	2282	240	39	22	-	-
November	3521	328	2780	684	50	20	8	3
December	3956	972	3070	1506	20	10	5	5

each other. It is observed that when the catch of one species was very high, that of the other was very much low. S. indica formed about 12-13% of the catch. It showed two peaks - February to May and November to December. The three species of Parapenaeopsis viz. P. sculptilis, P. hardwickii and P. stylifera together formed about 9-12%. Among these, the first was abundant at Mahul and the other two at Madh. H. ensirostris formed 3-4% of the catch, with peak abundance in March-May and September-December. Metapenaeus spp. and Atypopenaeus stenodactylus formed less than 1% in the catch. At Panaji, the fishery for P. stylifera, M. dobsoni and P. merguiensis was better in 1973, while M. affinis was predominant in the previous year. At Ambalapuzha, the inshore and offshore prawn fisheries in both the years were mainly supported by M. dobsoni, although P. stylifera and P. indicus contributed to substantial portion of the catches, particularly in the first year. Stray catches of M. affinis and M. monoceros were occasionally encountered during February-March period. At Colachel region, P. indicus was always the most dominant species in the fishery. It contributed to 96.9% of the prawn catches in 1972 and 99.2% in 1973. Other species occasionally represented in the catches of gill nets were large sized P. monodon, P. semisulcatus, P. merguiensis, M. dobsoni, M. affinis and P. stylifera. Of these, P. monodon was more common than the others. In 1972, Acetes indicus was landed in fairly good quantities by boat seines during June to September.

On the east coast, P. indicus was the dominant species in the prawn landings of Cuddalore-Porto Novo, Madras and Puri regions. In Cuddalore-Porto Novo region, in addition to this species, P. semisulcatus, M. monoceros

and M. dobsoni also supported the trawl fishery. At Madras, P. indicus contributed to 71% and 19% of the prawn catches in 1972 and 1973 respectively.

The estuarine prawn fishery of Machilipatnam was chiefly constituted by M. monoceros and M. dobsoni. The former species accounted for 40 to 70% of the prawn catches. Other species such as P. indicus, M. brevicornis and a few species belonging to the family Palaemonidae were also caught in lesser quantities.

10.5.3 Prawn fishery at other centres

Under the crustacean section of the Central Marine Fisheries Research Institute prawn investigations on a continuous basis are conducted at Veraval, Bombay, Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Madras and Kakinada. The magnitude of the offshore, inshore and estuarine fisheries in 1972 and 1973 in these centres together with the catch-per-effort is shown in Table X.

At Veraval and Bombay investigations are confined to the offshore and inshore regions. In Bombay continuous data are collected from Sassoon Dock, Versova and other nearby fishing villages. The catches by mechanised vessels operating trawls in Bombay accounted for 2100 tonnes in the two years, whereas the inshore "Dol" net fishery accounted for 1047 tonnes. Versova is one of the major fishing villages of the country where enormous quantities of prawns are landed by mechanised and non-mechanised boats operating "dol" nets. Landings are mainly constituted by the non-penaeid prawns as is found in the Project Centre, Madh Island. Total prawn landings in Versova alone accounted for 1361 and 1278 tonnes in 1972 and 1973 respectively (Table XI).

TABLE X

Prawn fishery at various centres with catch-per-effort data for the years 1972-73.

Centre	Year	Offshore fishery		Inshore fishery		Estuarine fishery	
		Catch in tonnes	Catch/ effort (Kg/hr)	Catch in tonnes	Catch/ effort (Kg/hr)	Catch in tonnes	Catch/ effort (Kg/hr)
Veraval	1972	33.5@	-	29.0@	2.14£	-	-
	73	483.8	-	-	-	-	-
Bombay	72	600.0	-	2769.0	-	-	-
	73	1500.0	-	1278.4	-	-	-
Karwar	72	175.8	-	2.1	-	3.8	-
	73	311.5	-	33.2	-	3.1	-
Mangalore	72	1538.6	55.9	0.039	-	-	-
	73	2112.7	-	52.8	-	22.1	-
Calicut	72	198.0	93.8	120.0	-	32.8	16.47
	73	635.5	-	51.0	-	33.3	7.1
Cochin	72	2141.0	15.8	-	-	897.8+ 877.8&	303.7 kg/acre
	73	6014.0	28.2	67.8	-	1540.5+ 881.1&	-
Tuticorin	72	-	-	-	-	-	-
	73	522.1=	-	109.9=	-	-	-
Mandapam	72	259.9	-	-	-	-	-
	73	267.4	-	-	-	-	-
Madras	72	134.6	2.2	7.4	1.0/Unit	-	-
	73	171.1	-	32.5	-	22.8	-
Makinada	72	865.8	12.8	-	-	321.8	11.16
	73	822.0	6.13	-	-	712.0	31.0

@Estimate for the first half of the year
=Estimate for the second half of the year
+From open estuary
&From paddy field
£Kg/net/day

TABLE XI

Estimated prawn landings (in kgs.) at Versova for 1972 and 1973 by 'Dol' nets.

Species	Year	January	Feb-ruary	March	April	May	June
M. affinis	1972	..	308	..	1760	800	72
	73	600	177	585	600	473	48
M. brevi-cornis	72	..	504	..	980	500	108
	73	200	327	345	975	120	48
P. stylifera	72	..	602	..	570	600	72
	73	520	177	1350	1650	630	46
P. hardwickii	72	..	4620	..	820	2050	112
	73	3260	6757	15375	1950	2100	48
P. sculp-tilis	72	..	1837	..	1500	900	152
	73	1560	728	2655	750	234	96
S. indica	72	..	13720	..	90260	6300	440
	73	11380	10061	43050	11175	5820	336
A. steno-dactylus	72	..	406	..	370	250	36
	73	300	2361	4725	1875	833	--
A. indicus	72	..	88410	..	51530	36000	7028
	73	52340	63934	159600	44625	22613	2880
P. tenuipes	72	..	18410	..	168190	292500	17720
	73	23820	10220	4980	166500	245850	22080
H. ensiros-tris	72	..	700	..	1400	1500	220
	73	2240	523	270	750	863	48
Miscel-laneous	72	..	686	..	1140	1100	120
	73	2180	915	2415	2400	1044	368
TOTAL	72	..	130200	..	325900	342500	26080
	73	98420	96180	235350	233250	280580	26000

TABLE XI Contd.

Species	Year	July & August	Sep-tember	Octo-ber	Novem-ber	Decem-ber	Total
M. affinis	1972	--	896	4290	5325	1889	15349
	73	--	--	480	915	816	4694
M. brevi-cornis	72	--	224	570	1343	1028	5257
	73	--	--	--	120	792	2947
P. styli-fera	72	--	2240	9310	9683	2040	25117
	73	--	--	25725	3300	4560	37970
P. hard-wickii	72	--	168	5740	26708	26100	73698
	73	--	--	120	16395	23334	69339
P. sculp-tilis	72	--	56	260	1095	2018	7815
	73	--	--	--	630	3978	10631
S. indica	72	--	--	48650	89250	35063	283683
	73	--	--	1560	55800	39870	179052
A. steno-dactylus	72	--	--	200	1673	1770	4705
	73	--	--	120	975	264	11453
A. indicus	72	--	1008	73900	69562	74700	407538
	73	--	--	21900	20805	41790	430487
P. tenuipes	72	--	4144	13150	68	1733	515915
	73	--	--	--	--	8052	481502
H. ensiros-tris	72	--	280	2000	870	1620	8590
	73	--	--	--	--	34140	38834
Miscel-laneous	72	--	504	1330	5438	3680	13998
	73	--	--	120	510	1554	11506
TOTAL	72	--	9520	164800	211015	151650	1361665
	73	--	--	50025	99450	159150	1278405

.. No data

-- No fishing

Prawn fishery at Karwar is comparatively poor; the total landings in 1972 and 1973 amounted only to 182 and 319 tonnes respectively, thereby showing an improvement in 1973. Mangalore had a sizeable prawn fishery by mechanised boats, the landings in the two years amounting to 3652 tonnes (Table XII). In 1972 the most productive period was March to May when 1023 tonnes of prawns were caught, whereas in 1973 better catches were registered in January, April, September and December.

The offshore catches of Calicut in 1972 were much less than that of 1973, being 198 and 636 tonnes respectively (Table XIII), whereas the inshore fishery with indigenous gear showed the opposite trend, being 120 tonnes in 1972 and 51 tonnes in 1973. Cochin recorded the maximum from offshore sources, having been 2141 and 6014 tonnes in 1972 and 1973 respectively; catch/hour having been 15.8 and 28.2 kg, indicating thereby that the level of abundance of prawn in this area was greater in 1973 than the previous year. This phenomenon was forecast in 1972. Similarly, Cochin area recorded a substantial estuarine fishery, both from the open estuary and paddy fields, the catches from both the sources amounting to 1776 and 2432 tonnes in 1972 and 1973 respectively (Table X).

Investigations commenced at Tuticorin late in 1973 and the estimated offshore and inshore landings for the second half of the year were 522 and 110 tonnes respectively. Prawn investigations started at Mandapam late in 1972. The estimated prawn landings by mechanised boats at Mandapam from September to December, 1972 were about 95 tonnes and in 1973 the landings for the whole year amounted

TABLE XII

Estimated prawn landings (in kg) at Mangalore in 1972 and 1973 by trawlers

Species	year	January	February	March	April	May	June
M. dobsoni	1972	29440	31040	124780	178060	149280	180
	73	24930	10340	58680	70130	15850	60
M. affinis	72	-	-	4830	5640	3160	90
	73	360	3640	5570	13390	3760	10
M. monoceros	72	-	-	-	-	-	-
	73	-	190	-	3800	170	-
P. stylifera	72	19470	24295	147290	182760	223950	3085
	73	213210	178740	139350	37039	61620	150
Penaeus sp.	72	230	300	300	1920	1310	115
	73	2900	1740	3100	6190	3090	10
TOTAL	72	49140	55635	277200	368380	377700	30470
	73	211400	194650	206700	463900	84490	230

TABLE XII Contd.

Species	Year	July & August	Sept-ember	Octo-ber	Nov-ember	Decem-ber	Total
M. dobsoni	1972	--	201625	25558	1661	2840	744464
	73	--	197260	50	3620	155850	536770
M. affinis	72	--	-	-	30	2909	16659
	73	--	-	-	-	-	26730
M. monoceros	72	--	-	19	-	58	77
	73	--	-	90	20	-	4270
P. stylifera	72	--	-	81361	23069	39186	771466
	73	--	-	30	5860	556520	1525870
Penaeus sp.	72	--	215	136	1294	146	5966
	73	--	260	-	230	1520	19040
TOTAL	72	--	201840	107074	26054	45139	1538632
	73	--	197520	170	9730	713890	2112680

-- No fishing

- No catch

TABLE XIII

Estimated landings (in kg) at Calicut in 1972 and 1973 by trawlers

Species	Year	January	February	March	April	May	June
M. dobsoni	1972	1824.0	964.5	..	..	..	..
	73	97268.1	7809.2	3091.7	1333.7	6978.1	803.0
P. stylifera	72	6776.7	1424.6	..	..	..	..
	73	32220.5	19357.2	20357.8	12851.6	50247.5	4535.0
P. indicus	72	1431.9	757.4	..	..	..	..
	73	19944.3	10362.2	10087.2	10389.1	6524.5	57.2
M. affinis	72	327.5	6.0	..	..	..	..
	73	41790.3	13231.4	23948.0	15220.4	3390.8	-
M. monoceros	72	..	99.5	..	..	..	-
	73	..	1751.8	1162.7	821.0	-	-
TOTAL	72	13060.1	3252.0	..	..	..	..
	73	191223.2	52511.8	67647.4	40215.8	67140.9	5395.2

TABLE XIII Contd.

Species	Year	July & August	Sep-tember	Octo-ber	Novem-ber	December	Total
M. dob-soni	1972	--	--	1972.6	6068.5	101710.4	112360.0
	73	--	--	58.0	12874.6	95803.0	226619.4
P. sty-lifera	72	--	--	3007.1	7567.0	40609.7	59385.1
	73	--	--	62.0	18077.6	77674.2	234983.4
P. indi-cus	72	--	--	7.3	1218.4	11221.6	14636.6
	73	--	--	-	-	6245.0	72609.5
M. affi-nis	72	--	--	-	28.3	11513.5	11875.3
	73	--	--	-	-	660.6	98241.5
M. mono-ceros	72	--	--	-	3.0	-	102.5
	73	--	--	-	-	-	3735.5
TOTAL	72	--	--	4807.0	14885.2	165055.2	198359.0
	73	--	--	120.0	30952.2	180382.8	635589.3

-- No fishing

.. No data

- No catch

to 267 tonnes. The outstanding feature in the Mandapam fishery is the preponderance of Penaeus semisulcatus, which is not found to this extent anywhere else along the Indian coast. The monthly prawn landings of Mandapam by mechanised boats in 1973 is shown in Table XIV.

TABLE XIV

Prawn landings by mechanised boats at Mandapam in 1973

Month	Quantity in kg
January	56322
February	21043
March	23345
April	24885
May	31041
June	33573
July	13284
August	19751
September	13947
October	12528
November	9714
December	7977
Total	267408

At Madras the estimated prawn landings by mechanised boats were only 135 and 171 tonnes in 1972 and 1973 respectively. In the east coast Kakinada had a lucrative prawn fishery. The mechanised boats landed 1688 tonnes of prawns

in the two years, details of which are given in Table XV. In 1972 the landings were very high in January and February. In 1973 more mechanised boats entered the fishery, though the total landings decreased from those of 1972.

Out of the estuarine fisheries along the west coast those of Calicut at Korapuzha and Cochin along the backwaters are quite substantial. The details of the catches of Korapuzha estuary are shown in Table XVI. In 1972 and in 1973 the landings accounted for 32.8 and 33.3 tonnes respectively, composed mainly of juveniles of M. dobsoni. Table XVII shows the particulars of the Cochin backwater prawn landings. Catches of 1973 were much better than those of 1972. Till 1972 the catches were declining, but in 1973 the fishery picked up and there was a considerable increase in the landings. Landings from the backwaters in 1972 and 1973 were 898 and 1541 tonnes respectively. The estuarine prawn catch from the backwaters and paddy fields of the Cochin area was estimated to be of the order of 4208 tonnes in the two years. It was possible to forecast the success of the fishery in 1973, when the backwater catches showed an increase of over 170%. Here, again juveniles of M. dobsoni dominated (about 75%).

The backwater prawn fishery at B.V. Palem in Kakinada was of considerable magnitude. The principal gears used in the fishery were stake nets and drag nets. Total landings by these two gears amounted to 322 and 712 tonnes in 1972 and 1973 respectively, showing considerable increase in the latter year (Table XVIII). M. dobsoni and M. monoceros were the main species constituting the catches.

TABLE XV

Prawn landings (in kg) at Kakinada in 1972 and 1973 by trawlers.

Species	Year	January	February	March	April	May	June
P. monodon	1972	4851	2310	4995	12060	4680	9420
	73	2695	1824	9863	4984	889	371
P. indicus	72	43056	10500	6102	3672	2007	8040
	73	2828	594	2373	7238	8925	6671
P. merguiensis	72	1242	492	243	549	207	714
	73	105	102	448	1071	238	203
M. monoceros	72	765	7590	2763	14985	17352	41640
	73	18494	11394	57995	28469	7560	2086
M. affinis	72	1629	576	45	823	855	9414
	73	3850	384	4186	4837	11214	8883
M. dobsoni	72	93240	111042	3600	9270	10800	11838
	73	26915	1080	11977	8764	36197	23002
M. brevicornis	72	6237	5082	549	594	2700	2106
	73	2695	432	5054	15939	11830	9002
P. stylifera	72	1026	1128	-	-	-	-
	73	231	108	1197	1057	1330	602
S. indica	72	765	1164	-	1458	990	1284
	73	112	168	945	455	14770	2779
P. hardwickii	72	-	-	-	-	-	-
	73	224	102	574	693	658	210
Other penaeids	72	594	1536	18	684	783	2490
	73	385	366	1883	4403	4830	1764
Non-Penaeids	72	540	792	-	234	900	1398
	73	301	216	3598	1862	11620	2975
TOTAL	72	153945	142212	18315	44334	41274	88344
	73	58835	16710	100093	79772	110061	58548

TABLE XV Contd.

Species	Year	July	August	September	October	November	December	Total
P. monodon	1972	3171	7707	3450	1715	2130	3785	60274
	73	2160	2241	448	3184	7308	5346	41313
P. indicus	72	5887	3997	2784	1295	1945	1410	90695
	73	4260	4653	2097	336	900	1344	42219
P. merguiensis	72	308	392	330	335	375	240	5427
	73	670	378	450	128	216	198	4207
M. monoceros	72	6832	7959	2664	5845	5720	3805	117920
	73	1680	1611	801	136	5304	2898	138428
M. affinis	72	7630	24640	11634	13675	3940	2970	77836
	73	4700	2916	6228	5392	6102	3384	62076
M. dobsoni	72	12257	7833	11172	13925	23210	11050	319237
	73	24230	6788	27603	35496	32496	18612	323160
M. brevicornis	72	6615	14105	20958	23520	16670	7695	106831
	73	7820	8415	3645	9432	14754	9306	98324
P. stylifera	72	4389	10199	2598	835	540	500	21215
	73	940	4437	2565	2504	2934	1632	19537
S. indica	72	1925	2527	648	820	425	230	12236
	73	1420	4852	1908	376	684	612	29011
P. hardwickii	72	-	-	-	-	-	-	-
	73	670	648	423	1912	888	354	7356
Other penaeids	72	3745	7945	4890	1750	1260	1160	26855
	73	710	6210	1449	672	1548	1182	25402
Non-penaeids	72	6524	11956	2190	1370	580	825	27309
	73	1800	4905	999	544	1338	672	30830
TOTAL	72	59283	99260	63318	65085	56795	33670	865835
	73	51060	118044	48616	60112	74472	45540	821863

TABLE XVI

Estuarine landings (in kg) at Korapuzha, Calicut for 1972 and 1973

Species	Year	January	February	March	April	May	June
P. indicus	1972	..	..	395	15	424	825
	73	63	870	1235	1420	4368	4310
P. monodon	72	..	..	100	10	72	185
	73	15	115	130	95	144	285
M. monoceros	72	..	..	665	175	296	1100
	73	165	1540	980	1575	5028	2380
M. dobsoni	72	..	..	320	125	128	575
	73	159	515	305	665	1848	2200
P. stylifera	72	-	-	-	-	-	-
	73	-	-	-	-	-	-
TOTAL	72	..	..	1410	325	920	2685
	73	402	3040	2650	3755	11388	9175

TABLE XVI Contd.

Species	Year	July	August	September	October	November	December	Total
P. indicus	1972	-	-	25	250	-	225	2089
	73	404	27.5	33.8	-		..	4682
P. monodon	72	-	25	40	33	-	67	532
	73	70	93.5	20.3	-	4	..	971.8
M. monoceros	72	20	170	150	1667	-	1308	5551
	73	245	462	79.9	220	312	..	12986.9
M. dobsoni	72	18.5	72.5	407.5	13333	-	9667	24645.5
	73	163.5	143	131.6	150	328	..	6608.1
P. stylifera	72	-	-	-	-	-	-	-
	73	-	-	-	-	28	..	28.0
TOTAL	72	37.5	267.5	622.5	15283	-	112.67	32817.5
	73	882.5	726	265.6	370	672	..	33326.1

.. No data
- No catch

TABLE XVIII

Backwater prawn catches (in kg) of Kakinada (B.V.Palem) in 1972 and 1973

Species	Year	January	February	March	April	May	June
P. monodon	1972	..	4620	1978	1082	..	702
	73	2903	2263	1889	781	672	484
P. indicus	72	..	1830	1174	1417	..	1548
	73	1039	427	379	1560	2076	1584
P. merguiensis	72	..	528	234	241	..	144
	73	199	134	152	173	200	190
M. monoceros	72	..	7086	5870	4669	..	4671
	73	9684	3514	3951	7251	6979	6744
M. affinis	72	..	261	635	278	..	342
	73	176	74	97	189	328	384
M. dobsoni	72	..	1287	1046	1940	..	1530
	73	1195	414	547	1036	1527	1162
M. brevicornis	72	..	1023	1834	1705	..	1278
	73	735	302	706	817	1159	1140
Other penaeids	72	..	2217	520	95	..	72
	73	606	250	296	1284	1093	1210
Non-penaeids	72	..	2238	569	790	..	783
	73	1078	507	563	1444	1221	952
TOTAL	72	..	21090	13860	12157	..	11070
	73	17635	7885	8480	14535	15255	13950

.. NO DATA

TABLE XVIII Contd.

Species	Year	July	August	Sept-ember	Octo-ber	Novem-ber	Decem-ber	Total
P. monodon	1972	2241	3226	2466	3312	4782	3359	27768
	73	1440	1000	1107	10254	10268	7980	41141
P. indicus	72	2861	3238	2450	1710	7889	3214	27331
	73	3015	1952	2988	6462	17514	8962	47958
P. merguiensis	72	256	374	371	423	1273	192	3544
	73	279	374	369	207	230	1126	3633
M. monoceros	72	16454	28244	10317	17064	3521	18304	131437
	73	11043	10252	12330	115167	10686	74182	367903
M. affinis	72	447	2870	2668	1224	810	361	9896
	73	315	288	207	993	1306	1892	6247
M. dobsoni	72	3395	2310	1472	1026	2575	1595	18176
	73	4140	922	837	6729	42784	50310	111503
M. brevicornis	72	1260	2540	1836	3726	5520	1293	22015
	73	2025	1235	999	1347	2828	15676	27519
Other Penaeids	72	492	1386	848	752	2597	201	9225
	73	1008	589	1557	1818	1976	4314	16001
Non-penaeids	72	1183	1361	1627	1602	4951	3675	18781
	73	1845	955	1386	9399	65698	6088	91156
TOTAL	72	28594	29095	24048	30879	65186	32194	268173
	73	25110	17565	21780	152376	249410	169080	713061

The principal species and the main season of the offshore catches of different centres are tabulated below (Table XIX).

TABLE XIX

Principal prawn species in the offshore catches of different centres

Centre	Species	Season
Veraval	Penaeus indicus, P. semisulcatus, Metapenaeus affinis, Parapenaeopsis stylifera.	November
Bombay	M. affinis, P. stylifera.	October to March
Karwar	M. affinis, M. dobsoni, P. stylifera	January to April
Mangalore	M. affinis, M. dobsoni, P. stylifera, P. indicus	December to April
Calicut	M. dobsoni, M. affinis, P. stylifera.	December to May
Cochin	M. dobsoni, P. stylifera, P. indicus, M. monoceros.	September, December and March to April
Tuticorin	P. indicus, P. semisulcatus, M. dobsoni, M. affinis.	July to October
Mandapam	P. semisulcatus.	January and April to June
Madras	P. indicus	June and October to November.
Kakinada	M. dobsoni, M. monoceros, M. brevicornis, M. affinis.	March to August.

10.6 Fishing effort and output

10.6.1 From Project Centres

The fishing effort expended in Bombay was 3,20,820 hrs. in 1972 and 2,51,041 hrs. in 1973. The catch returns in the case of prawns were at the rate of 12 kg/hr in the first and 9 kg/hr in the second year. The monthly catch rates varied between 6.2 and 16.5 kg/hr in the first year and 2.6 and 14.8 kg in the following year at Madh. The fishery was uniformly good in 1972 except in December. It was so in 1973 only between February and June. Fishing was poor in January, November and December and a total failure in October and November. At Mahul where the landings were not heavy the catch rates varied between 1.2 and 7.2 kg/hr. The fluctuations in the landings did not maintain uniformity in the catch rates.

The total number of units operated in the marine region at Panaji was 2216 and 533 in 1972 and 1973 respectively and the average catch rates were 25 kg and 17.6 kg/unit. The total fishing effort expended during the period at Ambalapuzha was 33,1406 hours for mechanised boats and 1,20,514 hours for non-mechanised boats, and the catch rate of prawn was 9 and 48 kg/hr respectively. In the estuarine fishery of Manakkudy lake, the total fishing effort expended in 1972 was higher than in 1973, although the catch rate was comparatively poor in that year. However, in the inshore fishery of the region, the fishing effort as well as the catch rate increased by about 70% in 1973 over that of previous year. The highest catch rate was recorded in June and August in both the years. At Colachel, the fishing

effort put in for the prawn fishery in 1972 and 1973 was considerably greater than at Manakkudy. The fishing effort as well as catch rate showed increase in this area.

The estimated total fishing effort recorded at Cuddalore and Porto Novo was about 4000 trawling hours but higher catch rate was generally recorded at Porto Novo. At Royapuram, the fishing effort declined from 77,376 hours in 1972 to 66,811 hours in 1973, but the catch-per-unit effort increased from 2.3 kg/hr to 2.8 kg/hr and this was mainly due to the unusual abundance of M. dobsoni in 1973. At Covelong also there had been a decline in fishing effort from 37156 hours in 1972 to 32,420 hours in 1973, but the catch rate, as in the case of marine fishery, showed improvement from 0.3 kg/hr to 0.4 kg/hr. This was mainly due to the threefold increase in abundance of M. monoceros and M. dobsoni in the backwaters. The catch rate of P. indicus declined slightly in 1973.

At Machilipatnam, normally 40 to 60 stake nets operated each day at each of the observation centres and the fishing effort in terms of hours varied from 1520 to 5784 in different months. In the observation centre at Chilka lake, the estimated effort during 1972-73 was 9038 hours and the catch-per-unit effort 0.68 kg/hr. The major portion of effort was expended during May to September period. In the marine region of Puri, 3,29,267 hours were spent during 1972-73 to realise a total catch of 92.8 tonnes of prawns at a catch rate of 0.28 kg/hr. Greater fishing effort was generally recorded during October-December.

10.6.2 From other centres

In the offshore catches the catch rate varied from 2.2 kg/hr in Madras to 55.9 kg/hr in Mangalore in 1973. Calicut recorded 93.8 kg/hr in the same year. Cochin registered a catch rate of 15.8 kg/hr in 1972 and 28.2 kg/hr in 1973, thereby indicating a much better level of abundance in 1973.

11. BIOLOGY OF THE COMMERCIALLY IMPORTANT PRAWNS

11.1 Age and growth

11.1.1 M. dobsoni

Studies carried out on the growth of the species from Goa waters have shown that the males and females respectively grow at an average rate of 2.25 and 3 mm per month. From the actual observation of the progress of modal sizes in the monthly length frequency distribution of the species at Ambalapuzha and applying the Von Bertlanffy's growth equation it has been estimated that the males and females respectively attain a length of 97/115 mm at the end of 1st year of life and 122/138 mm at the end of 2nd year, and that the females grow faster than males throughout their life.

11.1.2 M. affinis

At Bombay the females are noticed to grow at an average of 5 mm per month in the I year and 2.5 mm in the II and III years, thus measuring 60mm, 90 mm and 120 mm

At Puri, the average growth rate of the species has been recorded as 3 mm per month.

In the brackish waters of Manakkudy lake, the size mode of the juveniles of the species is observed at 66-70 mm in February when the fishing season commences. This mode, during the growth period of 87 days from 27.2.1973 in the case of males, and 77 days in females shifts to 116-120 mm, thereby registering an average growth rate of 0.57 mm per day in the former and 0.65 mm per day in the latter. The monthly growth rate of the species in this environment, thus works out to 17.10 mm for males and 19.50 mm for females.

The growth in the juvenile population of P. indicus in the Covelong Backwaters (Madras) is best examplified when the prawns are trapped inside the backwaters due to the closure of sand bar during May-November. During this period, regular shifting of size modes in the length frequency distribution was observed. Since the bar mouth was closed, the progressive increase of size should be due to growth only. When the bar is open, the immigration and emigration of prawns to and from the backwaters result in irregular distribution of size modes. The initial size mode, and the date in which it has been recognised, the final size mode and the date up to which the initial mode has been traced, duration, growth increment and the average rate of growth per month observed for the species in the Covelong backwaters are given in Table XX.

TABLE XX

Progression of size modes and growth pattern of juveniles of P. indicus at Covelong backwaters (Madras)

Initial position of size mode		Final position of size mode		The interval between initial and final positions	Growth observed during the period	Estimated growth per month (mm/ month)
Date	Modal size mm	Date	Modal size mm			
26.5.72	53 mm	23.8.72	123 mm	89 days	70 mm	23.3 mm
7.7.72	73 mm	29.8.72	113 mm	53 days	40 mm	22.6 mm
27.9.72	93 mm	9.11.72	133 mm	43 days	40 mm	28.0 mm
14.6.73	63 mm	18.7.73	93 mm	34 days	30 mm	26.5 mm
18.7.73	63 mm	6.9.73	103 mm	50 days	40 mm	24.0 mm
6.9.73	73 mm	25.9.73	93 mm	20 days	20 mm	30.0 mm
11.10.73	83 mm	20.11.73	103 mm	40 days	20 mm	15.0 mm

The average growth rate of the species in this ecosystem is found to be 24.2 mm per month. Based on this observation it may be inferred that the juveniles of 120 mm size, which are recruited into the marine fishery from the backwaters are about 5-6 months old.

In the Chilka lake, the maximum size of the species recorded was 120 mm. In March, the dominant size of the species was found at 61-65 mm and it gradually progressed to 106-110 mm in July, thereby showing a growth of 45 mm in 4 months. Similarly, the principal size group at 66-70 mm observed in July shifted to 106-110 mm in November thereby indicating a growth of 40 mm in 4 months.

The above observations indicate that the growth rate of the species varied considerably from place to place and in different environments. In the marine fishery, minimum growth rate was recorded at Colachel and this may be due to higher size range of the material studied. The growth rate of females observed in the fishery at Ambalapuzha and Madras was almost similar, but in the case of males, higher growth rate was recorded in the former region. In the estuarine region, the species was found to grow at a faster rate in the Covelong backwaters than in the Manakkudy lake or in Chilka lake. This disparity in the growth rate may probably be due to the availability of food and the environmental factors prevailing in the respective regions.

11.1.6 *P. merguiensis*

This species contributed to the fishery only at Goa and Puri among the eight centres investigated. Studies on the size frequency distribution of the species showed that in the former centre the rate of growth in the females was about 10 mm per month and in males only 5 mm. In Puri, its growth rate was relatively low, being only 3 mm per month. The tagging experiments conducted at Goa, however, indicated a growth rate of about 27 mm per month for this species in the younger stage.

11.1.7 *P. monodon*

Observations on the growth of the species were carried out only at Puri (Chilka lake) where it attained a maximum size of 190 mm. Small sized prawns were encountered throughout the year, but were abundantly caught during December-February. The size mode observed at 76-80 mm in February advanced to 126-130 mm in April, but its further progression

became slow. It was however, traced to 176-180 mm towards the end of the fishing season in August. Thus, the species showed a rapid growth rate of 25 mm per month in the younger stage, but the growth rate slowed down considerably as the animal attained adulthood.

11.1.8 Parapenaeopsis stylifera

Unlike the above species of penaeid prawns, this species spends its entire life in the marine region.

At Bombay it showed a monthly growth rate of 2.5 mm upto III year in males and IV year in females thus reaching 30, 60, 90 and 120 mm in length in the corresponding 4 years. The growth rate of the species off Goa waters was found to be 5 mm per month in females and 3.75 mm per month in males. At Ambalapuzha, P. stylifera attained an average growth rate of 5 mm per month in both the sexes in the size range between 50 mm and 115 mm and it attained a length of 91/98 mm at the end of I year of life and 117/123 mm at the end of II year in males and females respectively. Although differential growth rate between the two sexes was recorded in this species also, it is interesting to note that the growth rate (as estimated from Von Bertalanffy's equation) of the males of the species was much faster than the females during early 4 months of their life.

11.1.9 Other species

Some data on the size distribution of other commercial species like P. sculptilis, S. indica, A. indicus, P. tenuipes and H. ensirostris are available from Bombay centre. Although the growth rates estimated from this data are of limited value they are given in Table XXI.

11.2 Life span of major species

There have been several investigations on the age and growth of the commercial prawns of India. The growth pattern observed by earlier workers have shown that M. dobsoni has a life span of more than 2 years and it grows to 90-95 mm in the first year of life and 115 mm in the 2nd year. In the case of P. indicus males measuring 126-130 mm represent the one year old group, those at 161-165 mm the two-year old groups and those above 195 mm the three-year old groups, while females measuring 141-149 mm, 171-175 mm and above 195 mm respectively represent the identical age groups. P. stylifera is also believed to have a life span of 2 years, attaining 90-100 mm at the end of the first year and 126-130 mm by the second year of its life.

Studies at Bombay show that the growth rates in the successive years are the same for both the sexes in the case of M. brevicornis, P. stylifera, P. sculptilis, A. indicus and P. tenuipes; an exception to this being S. indica in which differential growth rates in males and females are noticed. The females are observed to grow to a larger size and live longer than the males. The rates of growth obtained for M. affinis and P. stylifera are very much slower than those recorded by others.

In the present study (Table XXI) it has been shown that all the species grow at a much faster rate than hitherto recorded excepting in some species at Bombay and that most of the species live for only 2 years.

11.3 Reproductive Biology

Maturity curves for the females of 9 species listed below were drawn and the size at maturity at 50% level was determined. The sizes are as follows:-

Species		Size (mm) at maturity
M. brevicornis	-	112.5
P. stylifera	-	105.5
P. sculptilis	-	122.0
P. hardwickii	-	85.5
S. indica	-	88.5
A. stenodactylus	-	38.3
A. indicus	-	29.5
P. temipes	-	50.5
H. ensirostris	-	60.5

The spawning season and peak spawning period of the various species at different regions are given in Table XXII.

Most of the species breed throughout the year and each of the species generally has 2 peak spawning periods. It is interesting to note that all the species on both the coasts of India show an intensive spawning during November-December. The other peak is generally observed during February-April, but in some species it extends upto June/July. Thus the earlier observations as well as the present data strongly support the hypothesis that the postmonsoon spawning peak of October-December is the most important one and the success or failure of the fishery depends largely on the intensity of spawning during post-monsoon period.

TABLE XXII

Spawning season and peak spawning period of commercial prawns at different centres

Centre	Species	Spawning period	Peak spawning period
Bombay	M. affinis	Throughout the year.	April and September
	M. brevicornis	Throughout the year	November and February-April
	P. stylifera	Throughout the year	September to November
	P. sculptilis	-do-	January to March
	P. hardwickii	September to May	September to November & January to February
	S. indica	October to April	March & November
	A. stenodactylus	March to May & November	March to April
	A. indicus	Throughout the year	November to March
	P. tenuipes	-do-	September to November
	H. ensirostris	-do-	September to December and March to May
Goa	M. dobsoni	-do-	February and November
	M. affinis	-do-	March, April and November to December

TABLE XXII Contd.

Centres	Species	Spawning period	Peak spawning period
Ambalapuzha	M. dobsoni	Throughout the year	April, June and October to December
	P. indicus	-do-	April, June and October to December
	P. stylifera	-do-	October to December
Colachel	P. indicus	-do-	February to May and October to November
Cuddalore	P. indicus	-do-	February to March, May to June and October to November.
Porto Novo	M. monoceros	-do-	January, May to July and September to October.

11.4 Behaviour - Schooling and local movements

At Ambalapuzha, large numbers of prawns particularly M. dobsoni and P. indicus were seen to congregate very near the shore in the mud-banks which are generally formed during the southwest monsoon period. Although, earlier workers have discussed the hydrological and ecological factors responsible for bringing out this lucrative fishery in the mud-bank region, the reasons for wide fluctuations observed in the landings in different years and for the occurrence of large shoals of P. indicus only in certain years are not fully understood. It is also interesting to note that during this period, the prawns are not encountered in their usual bottom habitat, but in the columnate pelagic zone.

In the Kanyakumari District, P. indicus supports a lucrative fishery only during the monsoon months from May to November, when they move into this area in large shoals. It is has been observed that in the fishing season the occurrence of prawns in different localities was erratic as the shoals that move to a region do not remain there for prolonged period.

At Machilipatnam the nature of the catches of stake nets suggests that M. monoceros and M. dobsoni exhibit independant gregarious movement. Generally, when M. monoceros was abundant in the catches, M. dobsoni was poor. It was also observed that during the full moon and new moon days the movements of these species become more intensive.

12. MARK-RECOVERY EXPERIMENTS ON COMMERCIAL PRAWNS

12.1 Method

Mark-recovery experiments were conducted at Panaji, Cochin and Madras to study the migratory pattern, growth, recruitment and mortality of the commercially important prawns. In order to select a suitable tag for large scale tagging of prawns, experiments were conducted in the laboratory during 1971, using different types of tags on three species of prawns. The results obtained indicated that the modified Petersen disc tag is more suitable than the loop tag which often hinders the natural movement of the prawn. Hence, further field experiments were carried out with the modified Petersen disc tag of the following specifications:-

1. Diameter of the 2 coloured plastic discs	8-9 mm
2. Thickness of the disc	0.8 mm
3. Length of the monofilament	100 mm
4. Diameter of the monofilament	0.3 mm

Field experiments on tagging of prawns were carried out in the inshore and offshore waters at Panaji, in both estuarine and inshore waters at Cochin and in the backwater regions at Madras. Live prawns were generally obtained from the commercial fishing units. The prawns thus obtained were conditioned in the tagging tubs for some time, the water in the tub being frequently changed to keep the prawns healthy and active. The prawn to be tagged was gently held under water and its sex and total length were determined and recorded in a register against the number of the tag to be used. The tagging was done with the help of a hypodermic needle (No.20 or 21). The prawn was held in the left hand and the needle on which one disc of the tag was already inserted was passed through the musculature of the 1st abdominal segment along the side without injuring the vital organs. The free end of the filament was taken through the bore of the needle, which was then retracted through the muscle and the disc (Fig. 2). The free end of the filament was then fused into a knob using a glowing stick. The locally obtainable incense stick (Agarbathi) was ideally suitable for this purpose. The tagged prawns were kept in separate tubs for one or two hours before releasing them into the water. The dead prawns were removed and only the active ones were carefully released into the water.

Publicity for the recovery of tagged prawns was arranged by distributing hand bills (Specimens shown in

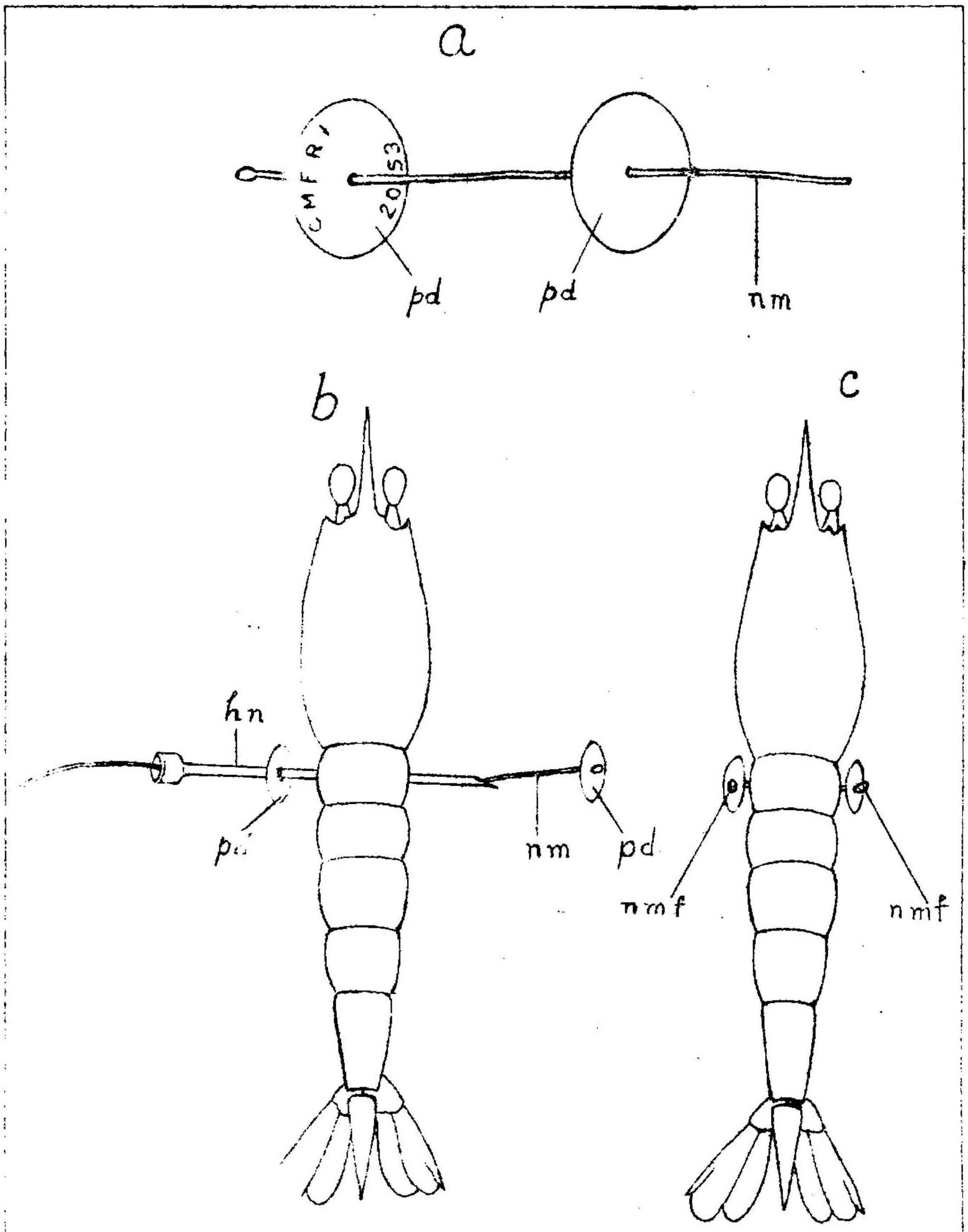

Fig.2. Tagging of prawns: a, Petersen disc tag (modified); b, insertion of tag; c, tag in position.

pd - plastic disc, nm - nylon monofilament, hn - hypodermic needle, nmf - fused end of nylon monofilament

Appendix II) and displaying wall posters in the fishing villages, fish landing centres, prawn processing centres and companies and in the fishermen co-operative societies. The hand bills were prepared in English as well as in local languages. They were distributed regularly sometime before the commencement of the experiment and continued periodically till about one month after the experiments were over. Wide publicity was arranged through the local newspapers while the experiments were in progress in 1973. Co-operation of the State Fisheries Departments was also utilised. A reward of Rs.3/- was offered to those who brought prawns with details of data and place of recapture.

12.2 Experiments in Goa

Various species of prawns were tagged and released in the inshore and offshore areas off Panaji within a depth range of 4 to 30 metres, details of which are given in Table XXIII. In 1973 a total of 290 prawns of different species were tagged and released, out of which 21 were recovered, registering a recovery rate of 7.2%.

All the prawns were released in inshore shallow areas where there was moderately intense fishing activities, whereas most of the 134 prawns released in early 1974 was in areas of 20-30 metres depth where small mechanised boats usually do not operate, thereby probably decreasing the chances of recovery. All the prawns released in deeper waters, particularly *M. monoceros*, did not register a single recovery. This may be due to the smaller vessels usually not operating in this depth zone. In 1974, all the prawns were tagged and released from the Government of India trawlers which normally

TABLE XXIII

Total number of prawns tagged and recovered in Goa

Species	1973 Total No. tagged	1973 No. recovered	1973 %	1974 Total No. tagged	1974 No. recovered	1974 %
M. affinis	169	15	8.9	2	-	-
M. dobsoni	55	3	5.5	51	1	2.0
M. monoceros	-	-	-	72	-	-
P. merguiensis	2	-	-	5	-	40.0
P. indicus	-	-	-	3	-	-
P. monodon	1	-	-	-	-	-
P. stylifera	63	3	4.8	1	-	-
TOTAL	290	21	7.2	134	3	2.2

operate outside the zone where smaller private boats operate. Overall rate of recovery in 1974, therefore was much less than that of 1973. The recovery rate in 1973 was quite significant, overall recovery being 7.2%, M. affinis registering a recovery rate of 8.9%.

Details of recoveries made are presented in Table XXIV. The longest period from the date of release to the date of recovery was 18 days. A specimen of M. affinis of 1973 and another of P. merguiensis of 1974 remained at liberty for 18 days. The longest distance from the place of release to the place of recovery was about 60 kms,

TABLE XXIV

Particulars of recoveries of tagged prawns in Goa (Panaji) in 1973 and 1974

Species	Release		Recovery		Distance between place of release and recovery (km)	Size at		Sex	Length increase in mm	No. of days at liberty	Direction of movement
	Date	Location	Date	Location		Release	Recovery				
1	2	3	4	5	6	7	8	9	10	11	12
M. affinis	6.2.73	Off Calangute	9.2.73	Calangute	-	114	114	Male	Nil	3	-
-do-	-do-	-do-	12.2.73	Aguada	4	115	115	-do-	Nil	6	S.
-do-	15.2.73	Aguada	20.2.73	Off Vasco da Gama	15	106	106	-do-	Nil	5	S.
-do-	-do-	-do-	15.2.73	Calangute	4	95	95	-do-	Nil	-	N.
-do-	-do-	-do-	20.2.73	Off Aguada	1	134	136	Female	2	5	E.
-do-	-do-	-do-	15.2.73	Calangute	3	110	110	-do-	Nil	-	N.E.
-do-	-do-	-do-	22.2.73	Aguada	1	104	105	Male	1	7	E.
-do-	-do-	-do-	19.2.73	Calangute	4	114	114	Female	Nil	4	N.
-do-	-do-	-do-	16.2.73	-do-	4	120	120	-do-	Nil	1	N.E.
-do-	-do-	-do-	21.2.73	Off Vasco da Gama	15	139	141	-do-	2	6	S.

TABLE XXIV Contd.

1	2	3	4	5	6	7	8	9	10	11	12
M. affinis	15.2.73	Aguada	24.2.73	Calangute	4	122	122	Female	Nil	9	N.
-do-	-do-	-do-	23.2.73	Aguada	1	120	120	-do-	Nil	8	E.
-do-	21.2.73	Anjuna	25.2.73	Vasco da Gama	19	115	115	-do-	Nil	4	S.
-do-	15.2.73	Aguada	27.2.73	Aguada	-	119	124	-do-	5	12	-
-do-	-do-	-do-	5.3.73	Calangute	4	142	146	-do-	4	18	N.
M. jobsoni	21.2.73	-do-	21.2.73	Aguada	-	100	100	-do-	Nil	-	-
-do-	-do-	Anjuna	6.3.73	Calangute	5	104	106	-do-	2	13	S.
-do-	15.2.73	Aguada	25.2.73	Redi (Vengurla)	60	106	112	-do-	6	10	N.
-do-	22.1.74	Calangute	22.1.74	Calangute	-	94	94	-do-	-	-	-
P. stylifera	6.2.73	-do-	13.2.73	-	-	105	105	-do-	-	7	-
-do-	8.2.73	Aguada	-do-	-	-	75	75	-do-	-	5	-
-do-	15.2.73	-do-	19.2.73	Calangute	4	105	105	-do-	Nil	4	N.
P. merguiensis	22.1.74	Calangute	22.1.74	-do-	-	94	94	-do-	Nil	-	-
-do-	-do-	-do-	9.2.74	-do-	-	110	126	-do-	16	18	-

S - South; N- North; E - East.

in the case of one M. dobsoni released at Aguada at the entrance of the Mandovi estuary; the prawn having travelled towards north to Redi, outside the boundary of Goa. The period at liberty in this case was 10 days. Travelling 60 kms. in 10 days may perhaps be a remarkable instance of migratory speed.

Except in the case of a P. merguiensis growing 16 mm within a period of 18 days, all the other cases of growth increments were within known limits. Recoveries indicate an overall movement towards the north, though much of the movement was within the fishing ground itself. Fig. 3 depicts the migratory course of the tagged prawns. Out of the 24 recoveries, 5 were males and the other females.

12.3 Experiments in Cochin

At Cochin, large scale tagging of prawns was commenced from the middle of 1972 and it was carried out both in the backwaters and inshore regions. All the five commercial penaeid prawns viz., Metapenaeus dobsoni, M. monoceros, M. affinis, Penaeus indicus and Parapenaeopsis stylifera were taken up for tagging. In the backwaters, juveniles of M. monoceros and P. indicus were selected while M. dobsoni was the main species tagged in the sea. The number of specimens tagged and released in the Cochin Backwaters and in the inshore sea is given in Table XXV.

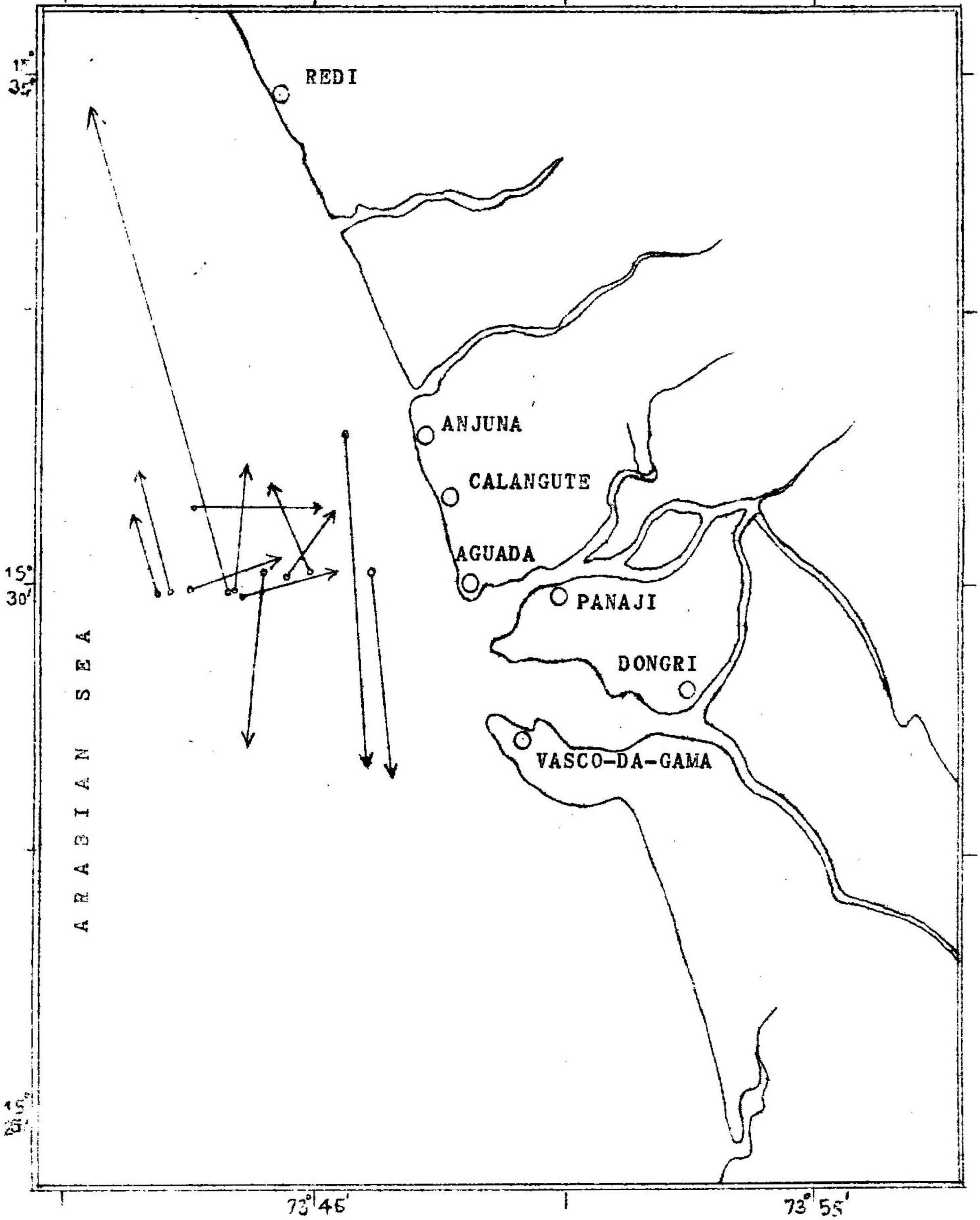

Fig.3. Migratory pattern of tagged prawns off Goa

TABLE XXV

Details of prawns tagged at Cochin during 1972 and 1973

Region	Place of capture	Species tagged	Total No.	Place of release	Depth in Mtrs.	Size range (mm)	No.of prawns recovered
1972							
Cochin back-water	Thevara canal	*M. monoceros*	570	Cochin back-water	3	63-116	2
-do-	-do-	*P. indicus*	54	Thoppum-pady canal	3	58-135	-
Inshore sea	Off Cochin	*M. dobsoni*	397	off Cochin	10	59-130	2
		P. indicus	8			120-147	
		P. stylifera	14			80-95	
1973							
Inshore sea	Off Cochin	*M. dobsoni*	332			50-103	1
		P. indicus	18	Off Cochin	10-15	90-140	
		P. stylifera	98			72-111	
		M. affinis	73				

During 1972 when tagging experiments were mainly carried out from the backwaters, 570 specimens of *M. monoceros* and 54 specimens of *P. indicus* obtained from Stake nets were tagged and released near the Cochin bar mouth, of which 2 specimens of *M. monoceros* were recovered. In the marine region, altogether 729 specimens of *M. dobsoni*, 112 *P. stylifera*, 73 *M. affinis* and 26 *P. indicus* were tagged and released during 1972 and 1973. Out of these 2 specimens of *M. dobsoni* and a single specimen of *P. stylifera* were recovered. The details of recoveries and the migratory course are shown in Table XXVI and Fig.4 respectively.

TABLE XXVI

Particulars of recoveries of tagged prawns at Cochin during 1972 and 1973

Species	Details of release			Details of recovery				Distance between place of recovery & release (km)	Size at		No. of days at liberty	Direction of movement
	Date	Place	Depth (Mtrs.)	Date	Place	Gear	Depth (Mtrs.)		Release (mm)	Recovery (mm)		
M. monoceros	7.9.72	Thopumpady	3	12.9.72	Kumbalam	Drag net	1	4	91	91	5	-
M. monoceros	7.10.72	Thopumpady	3	17.9.72	Thevara canal	Drag net	1	½	77	81	10	-
M. dobsoni	27.11.72	Off Cochin	10	1.12.72	Off Malipuram	Trawl	12.5	5.5	85	85	4	N
M. dobsoni	27.11.72	Off Cochin	10	5.12.72	Off Azhicode	Trawl	15	25	90	90	8	N
P. stylifera	15.12.73	Off Cochin	10	17.12.73	Off Cochin	Trawl	10	-	95	95	2	-

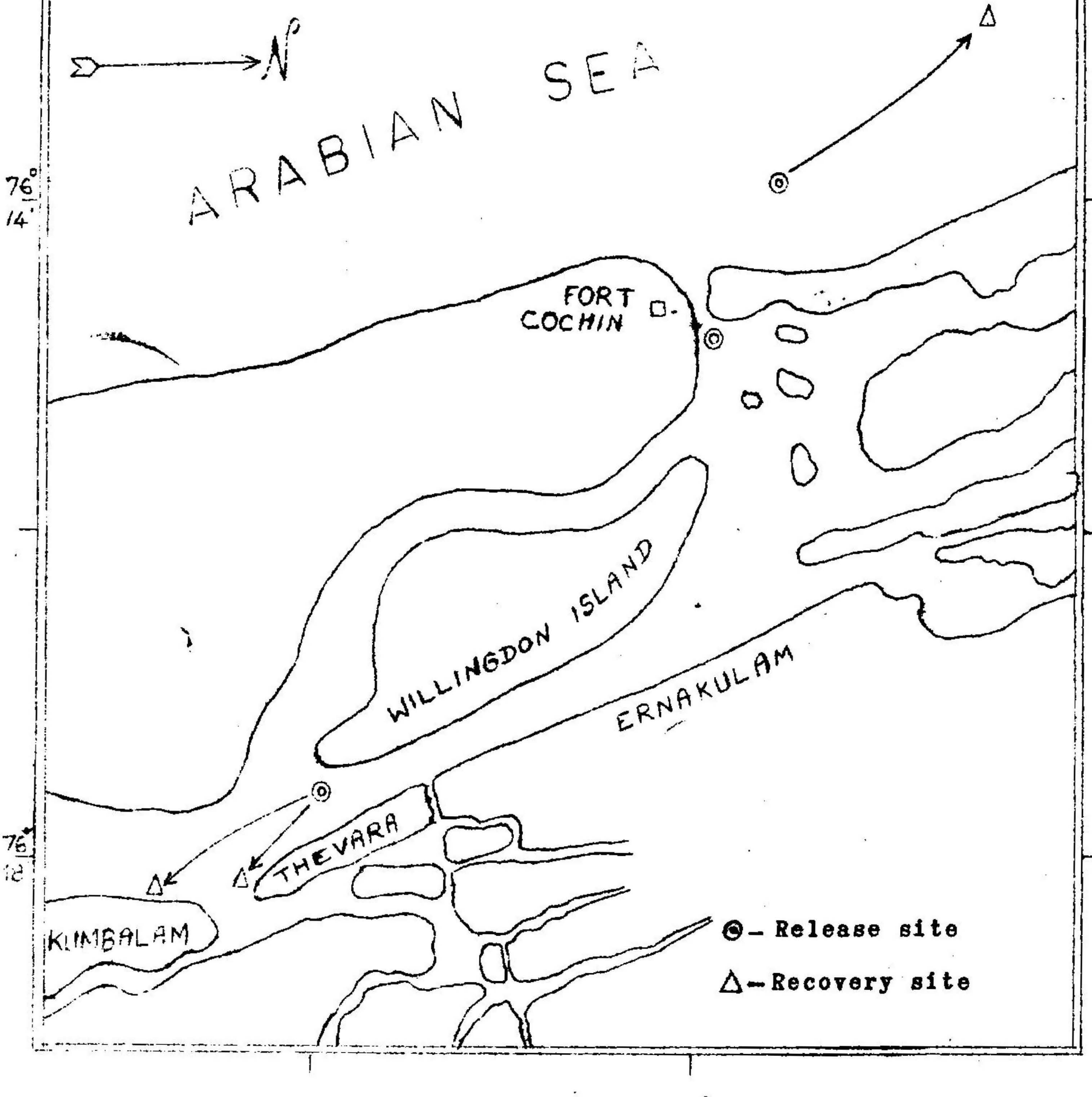

Fig. 4. Migratory pattern of tagged prawns in Cochin

The results obtained from these preliminary experiments indicated that 1. the modified Petersen disc tag is suitable for tagging prawns measuring above 40-45 mm size and it is retained by the prawns in their natural habitat and during moulting. 2. the recovery rate of tagged prawns both in the backwaters and marine region is relatively small, 3. the recoveries occurred within 2-10 days after release of tagged prawns and 4. the movement of prawn is restricted and seen within the fishing ground, the maximum distance travelled by M. dobsoni at one instance being 25 km in the marine region during a period of 8 days.

12.4 Experiments in Madras

At Madras, juveniles of P. indicus and P. monodon (70 mm - 130 mm) caught by cast nets in the backwaters at Ennore and Pulicat were tagged and released in these backwaters. The number of P. indicus tagged at Ennore and Pulicat were 553 and 648 respectively.

Thirty nine P. indicus and one P. monodon were recovered. The details of recoveries are given in Table XXVII.

TABLE XXVII

Tagging details in Madras

Tag No.	Initial length (mm)	Final length (mm)	Date and place of release	Date of recovery	Time interval between release & recovery	Growth during the period
1	2	3	4	5	6	7
2067	93	93	Ennore	4.6.73	4 days	Nil
2071	97	97	1.6.73	4.6.73	4 days	Nil
2078	86	86	1.6.73	5.6.73	5 days	Nil
2081	92	92	1.6.73	5.6.73	5 days	Nil
2090	97	104	1.6.73	12.6.73	12 days	7 mm
2093	103	103	1.6.73	4.6.73	4 days	Nil
2098	89	89	1.6.73	4.6.73	4 days	Nil
2100	98	103	1.6.73	15.6.73	10 days	5 mm
2102	94	104	1.6.73	15.6.73	15 days	10 mm
2112	102	-	1.6.73	13.6.73	13 days	Decomposed
2395	81	81	Ennore 16.6.73	10.6.73	4 days	Nil
1511	86	86	Ennore 24.5.73	26.6.73	2 days	Nil
1512	84	84	24.5.73	26.6.73	2 days	Nil
1569	79	79	24.5.73	24.6.73	1 day	Nil
1655	86	86	24.5.73	28.6.73	4 days	Nil
2156	104	103	Pulicat 7.6.73	17.6.73	10 days	- 1mm
2230	111	83*	Pulicat	18.7.73	5 days	*
2233	98	98	Pulicat	15.7.73	2 days	Nil
2241	102	101*	Pulicat	16.7.73	3 days	- 1 mm

TABLE XXVII Contd.

1	2	3	4	5	6	7
2246	105	101*	Pulicat	14.7.73	1 day	*
2247	117	115*	Pulicat	17.7.73	4 days	*
2249	109	108	Pulicat	15.7.73	2 days	- 1 mm
2251	110	104*	Pulicat	15.7.73	2 days	*
2253	97	95*	Pulicat	16.7.73	3 days	*
2258	108	100*	Pulicat	17.7.73	4 days	*
2262	101	99	Pulicat	14.7.73	1 day	- 2 mm
2267	113	113	Pulicat	17.7.73	4 days	Nil
2269	111	108*	Pulicat	14.7.73	5 days	*
2271	118	107*	Pulicat	14.7.73	1 day	*
2273	109	109	Pulicat	14.7.73	1 day	Nil
2275	95	94	Pulicat	14.7.73	1 day	- 1 mm
2297	103	101	Pulicat	15.7.73	2 days	- 2 mm
2401	108	87*	Pulicat	18.7.73	5 days	*
2402	108	93*	Pulicat	15.7.73	2 days	*
2407	95	94	Pulicat	16.7.73	3 days	- 1 mm
2409	103	102	Pulicat	16.7.73	5 days	*
2433	100	86*	Pulicat	18.7.73	5 days	*
2469	81	82	Pulicat	17.7.73	4 days	1 mm
2473	82	80*	Pulicat	17.7.73	4 days	*
			P. monodon			
2085	116	124	Ennore	9.6.73 1.7.73	9 days	8 mm

* Rostrum broken in recovered prawn.

Most of the prawns were recovered within 5 days after release and did not show any growth increment. All of them were recovered in the estuary within a radius of 3 km from the point of release. The longest time interval between release and recovery was 15 days and the prawn had grown 10 mm revealing remarkably high rate of growth (20 mm/ month).

Some recovered prawns showed a slight reduction in length. This may be due to shrinkage of the prawns which were preserved in formalin. In many cases the rostrum was broken. It is therefore suggested to record both carapance and total length of the prawns to be tagged.

13. POPULATION CHARACTERISTICS

13.1 Bombay region

13.1.1 Sex ratio

The males and females of M. monoceros, M. brevicornis and P. sculptilis occurred in the ratio of 1:1 and of P. stylifera, P. hardwickii, A. stenodactylus and P. tenuipes in the ratio of 1:2. The sex ratio showed wide disparity in S. indica and A. indicus. At times the ratio of males to females was 1:11 in the former and 1:8 in the latter.

13.1.2 Size composition

13.1.2.1 M. affinis

The size range for the males was 41-143 mm with the mean size of 93 mm in 1972-73. The females were in the size range 26-172 mm and their mean sizes increased from 72 mm in 1972 to 77 mm in 1973.

13.1.2.2 M. monoceros

The size ranges and their mean sizes did not differ much in the two sexes during the two years at Mahul. In 1973, the size range for the males was 62-99 mm with the mean size of 74 mm and for the females it was 31-97 mm with the mean sizes of 69 mm.

13.1.2.3 M. brevicornis

The sizes ranged between 47 and 95 mm in males and 29 and 134 mm in females at Madh. The mean sizes dropped from 78 to 76 mm in males and 91 to 86 mm in females in the two years. At Mahul the size range did not differ much from that at Madh in the case of males but in females it was 40-138 mm. The mean sizes showed upward trends from 69 to 71 mm in males and 80 to 82 mm in females in the two years.

13.1.2.4 P. stylifera

The size ranges were 28-105 mm for males and 18-127 mm for females at Madh and 35 to 87 mm for males and 23-127 mm for females at Mahul. The mean sizes had gone up at Madh from 74-79mm in males and 71-87 mm in females and at Mahul from 62-68 mm in males and 59-65 mm in females in the two years.

13.1.2.5 P. sculptilis

The size ranges did not differ much in the two centres for both the sexes. At Mahul it was 35-117 mm for males and 28-154 mm for females. While the mean sizes for

the males and females improved at Madh from 75-81 mm and 94-98 mm respectively in the two years, they were reduced at Mahul from 87-83 mm for males and 100-87 mm for females.

13.1.2.6 P. hardwickii

The size ranges were 27-67 mm for males and 40-115 mm for females at Madh with the mean sizes 55 and 56 mm in the former and 94 and 92 mm in the latter in the two years. The size ranges at Mahul for males was 37-62 mm and for females 24-92 mm with the mean size at 65 mm in 1973.

13.1.2.7 S. indica

The size ranges in the two centres were almost the same in both the sexes, they being 21-79 mm for males and 11-107 mm for females at Madh. While the mean sizes for males slightly moved up from 48-49 mm at both the centres they showed a fall from 51-49 mm at Madh and 64-57 mm at Mahul in the two years for the females.

13.1.2.8 A. stenodactylus

The species appeared in 1973 only at Madh. The size range for males was 22-64 mm with the mean size at 48 mm and 19-95 mm for females with the mean size at 64 mm.

13.1.2.9 A. indicus

There was not much difference in the size ranges at the two centres. In common they were 10-33 mm for males and 10-38 mm for females. At Madh the mean sizes for the

former was 21 mm in both the years and 26 and 28 mm for the latter in the two years. At Mahul the mean sizes improved from 16-21 mm for males and 21-24 mm for females.

13.1.2.10 P. temuipes

The size ranges were 16-87 mm for males and 11-96 mm for females at Madh and 21-62 mm for males and 16-68 mm for females at Mahul. But, at both the centres and in both the sexes, the mean sizes which did not vary much, showed a definite fall in the second year from 43 and 44 mm to 40 mm in males and from 44 to 34 mm and 43 to 39 mm in the females.

13.1.2.11 H. ensirostris

The size ranges were 18-99 mm at Madh and 23-81 mm at Mahul. While the mean size dropped from 66-62 mm at Madh, it remained steady at 59 mm at Mahul in the two years.

13.1.3 Age composition

The fishery of almost all the species comprised mainly of the I and II year classes in Bombay. In M. affinis and P. sculptilis small percentage of III year class and in P. stylifera III and IV year classes also contributed to the fishery. In A. indicus the I year class dominated the catch.

13.1.4 Spawning population

The spawning population at Madh were very high in P. hardwickii forming 70.7% and also in H. ensirostris

forming 54.0%. In M. brevicornis, P. stylifera and P. sculptilis the spawners were about 33% of the population; in A. indicus and P. tenuipes about 25% and lastly in A. indicus and A. stenodactylus they were less than 20% of the population.

At Mahul the spawners were less than 20% of the populations in all the species except P. sculptilis in which they formed about 25%.

13.1.5 Recruitment

In 1972-73, recruitment of the smaller sizes to the fishery took place during greater part of the year. In the case of P. sculptilis the recruitment of 26-40 mm and in S. indica, of 11-20 mm took place almost throughout the year. In A. indicus size of 9-12 mm and in P. tenuipes, the size of 11-20 mm entered the fishery more than 6 times in a year. Recruitments of the size 26-40 mm in the case of M. brevicornis and of 16-25 mm in the case of P. stylifera to the fishery were every 3 months. M. monoceros of the size 31-40 mm and H. ensirostris of 16-20 mm were recruited twice in a year.

13.2 Goa Region

13.2.1 Sex ratio

In the population of M. dobsoni, males were significantly more numerous in most of the months except in April and September 1972, December 1972 to February 1973 and in November, 1973. In the case of P. stylifera, males dominated in the catches in April, June and October, 1972 and

in June, and March to May, 1973. The population of M. affinis and Penaeus merguiensis were chiefly composed of females.

13.2.2 Size composition

In the trawl catches, the size of M. dobsoni ranged from 40-125 mm for females and from 35-115 mm for males. After the southwest monsoon, when the trawl fishing season commenced in September - October, the catches were dominated by larger females of 111-120 mm size group. From December to March, slightly smaller females of 85-110 mm size supported the bulk of the landings and during the rest of the season, generally small sized females predominated in the catches. In the beginning of the season, although males were poorly represented in the catches, their population was composed of relatively larger prawns belonging to 96-100 mm size group. As the season advanced, this size group disappared from the fishery by October, and it was replaced by the newly recruited group of smaller prawns in the size group 71-75 mm and this group of prawns predominated the fishery during the rest of the season.

The size of M. affinis landed by trawl nets ranged from 40-190 mm in females and 35-170 mm in males. Soon after the monsoon, the marine catches were dominated by males and females of 121-130 mm size groups. The larger females (136-140 mm) and males (126-130 mm) disappared from the fishing ground by December. By January, females belonging to 131-135 mm size, and males of 116-120 mm size dominated in the catches. During the rest of the season, relatively smaller prawns of 106-125 mm size groups contributed to the fishery.

The size of P. stylifera ranged between 25 mm and 150 mm in females and between 30 mm and 120 mm in males. When the trawl fishery commenced after the monsoon, the catches were chiefly composed of females belonging to 91-95 mm and 106-110 mm size groups and males to 91-95 mm. The larger females (106-110 mm) disappared from the fishery by December and in the same month, large scale recruitment of juvenile males (20 mm) and females (40 mm) of the species took place. During December-January and April, the fishery was chiefly supported by the population belonging to 96-110 mm length group, while in June younger prawns of 56-60 mm were predominant. It is interesting to note that males in the size group of 80-110 mm dominated the catches throughout the season.

In the trawl catches, the size of P. merguiensis ranged from 70 to 120 mm in females and 80-195 mm in males. During the monsoon months this species was mainly caught from river mouths by gill nets and its size varied from 95 mm to 165 mm in males and 95 mm to 195 mm in females. In July-August, the gill net catches were dominated by males of 130-150 mm and females of 140-160 mm size.

The size composition of the species in the trawl catches of October was composed of females belonging to 96-100 mm. In case of males, 2 size modes, a smaller one at 101-106 mm and the larger at 156-160 mm were observed. By December-July, the larger prawns disappared from the ground and during the rest of the season, females belonging to 135-146 mm and males to 130-140 mm size group dominated the fishery.

13.2.3 Spawning population

The spawning population of M. dobsoni was chiefly composed of females between 81-85 mm and 110-120 mm size group, while in M. affinis, the prawns in the size range of 111-145 mm breed activity in this region. The low percentage of females recorded during different months suggests that the latter species breeds in deeper waters than the presently exploited fishing grounds. In P. stylifera, active breeders were generally encountered in the size group between 101-105 mm and 111-115 mm from December to April in the size range of 90-125 mm. In P. merguiensis the spawning population consisted of females measuring between 141 and 185 mm; larger females above 150 mm being dominant from October to January and the smaller prawns of 141-145 mm size from January to April.

13.3 Ambalapuzha region

13.3.1 Sex ratio

13.3.1.1 M. dobsoni

The overall male to female sex ratio was found to be 1:1.9 in all the months except in December 1971 and July 1972. The males were generally seen in higher proportion than females in lower size groups upto 71-75 mm. In the higher size groups, the ratio of females increased and above 101-105 mm size the population was almost entirely composed of female prawns.

13.3.1.2 *P. stylifera*

In its population the sex ratio of male to female was 1:1.3. In the monthly sex ratio distribution, males were dominant in December 1971, March, May, November and December 1972. Size-wise distribution of sex ratios showed preponderance of males in the size groups below 81-85 mm, while in the larger size groups females were in far excess of males. In April - May and September the females were found to be dominating in the lower size groups also.

13.3.1.3 *P. indicus*

The overall male to female sex ratio was 1:2.2. As in the case of the preceeding two species, females were predominant in the catches upto 141-145 mm size group in all the months, the sex ratio distribution showed little consistency as the males and females were found in varying proportions in different months. In the size group above 146-150 mm, females were generally encountered in greater numbers than males except in March 1972.

13.3.2 Size composition

13.3.2.1 *M. dobsoni*

The size ranged from 52 mm to 110 mm in males and from 51 mm to 121 mm in females. In the trawl fishery, the males were mainly composed of the 66-95 mm size groups. Smaller prawns below 60 mm size were encountered from October to May, while the larger prawns above 95 mm size were abundant in the catches of April-May, 1973. In females, majority of prawns belonged to 66-100 mm size, but those above 100 mm size were also caught in appreciable numbers from

October to May. Small sized females below 60 mm were represented in the catches landed in February, May, October and December 1972 and again during February-May, 1973.

In the mud-bank fishery of July, the principal size of the species was found at 81-100 mm for males and at 91-115 mm for females.

The monthly mean size of males of M. dobsoni varied between 64.5 mm and 91.5 mm and that of females between 73.6 mm and 98.5 mm. The lowest mean size for males was recorded in November 1972, while for felames it was in January. The highest mean size for both the sexes was observed in July. There was little consistency in the distribution and progression of mean sizes in different months, indicating irregular pattern of incursion of prawns belonging to different size groups into the fishery and their wide fluctuations in abundance.

13.3.2.2 P. stylifera

The size ranged from 51 mm to 109 mm in males and from 52 mm to 123 mm in females. In the commercial catches, majority of males belonged to 61-90 mm in length groups. In females, the dominant size group in the fishery was found to vary between 66 mm and 100 mm size. However, in February 1972 and from February to April 1973, larger number of prawns belonging to the smaller as well as larger size groups were also seen to contribute to the catches.

The mean size of P. stylifera varied between 70.3 mm and 90.9 mm in males and between 74.6 mm and 99.4 mm in females. The lowest mean size for males was observed in April 1972 and for females in June 1973. The highest mean size was recorded in April 1973 for both the sexes. As in the case of M. dobsoni the distribution of mean sizes in different months showed no definite pattern.

13.3.2.3 P. indicus

The catch was composed of individuals ranging in size from 96 mm to175 mm in males and from 97 mm to 180 mm in females. The trawl fishery for the species in January 1972 was mainly contributed by the prawns belonging to the size groups between 96-100 mm and 136-140 mm but, as the season advanced, a gradual incursion of larger prawns was noticed and in May the dominant size groups were found at 161-165 mm in males and 151-155 mm in females. After the rainy season, when the trawl fishery commenced in October 1972 the dominant size of males was at 146-150 mm. In the subsequent months till April, the modal size of the species was seen varying between 131-135 mm and 146-150 mm. However, in May 1973, large size males with the modal size at 161-165 mm were abundant. The principal size of the females during the period was found between 136-140 mm and 150-160 mm.

During the beginning of the mud-bank fishery in July, males were poorly represented in the catch, while the female population consisted of relatively smaller prawns (106-145 mm) but in August, both males and females were more or less of the same size group viz. 121-166 mm.

The mean size of P. indicus in the trawl fishery varied from 113.0 mm to 154.6 mm in males and 117.6 mm to 169.3 mm in females, whereas in the mud-bank fishery of July and August, it was 113.0 mm and 145.4 mm for males and 130.9 mm and 150.2 mm for females. In the case of males, a gradual progression of mean size from 125.8 mm in January 1972 to 145.7 mm in May 1972 was observed. A similar progression of mean size from 141.8 mm to 145.3 mm during March-May, 1973 period was also discernible. However, in the case of females there was no regularity in the distribution of mean size in different months.

13.3.3 Age composition

13.3.3.1 M. dobsoni

Seven to twelve months old prawns formed the bulk of the catch in all the months. Males of less than 6 months old were abundant in the catches during March-May 1973 and the females of the same age from October to May. The males belonging to 13-18 months of age group were found in appreciable numbers only in December 1971 and July 1972. The females of this age group were generally scarce in the fishery except in April-May 1973.

13.3.3.2 P. stylifera

The bulk of the catch was composed of 7-12 months old prawns. Males 1-6 months old, were completely absent in the fishery during May to August 1972 and in June 1973; but they were well represented in November 1972 and March-May 1973. In April 1973, 13-18 months old prawns were also

caught in appreciable numbers. In females, the highest number of 1-6 months old prawns were caught in March-May 1973; 13-18 months old prawns in April 1973. 19-24 months old prawns did not contribute to the fishery except in February 1972 and April 1973.

13.3.3.3 P. indicus

The fishery was chiefly supported by the prawns belonging to 7-12 months age group in the case of males and 13-18 months old prawns in females. In most of the months males of less than 6 months old were poorly represented in the fishery, while 13-18 months old prawns were abundant in April 1972 and May 1973 contributing to the bulk of the catch. Females of less than 6 months old were completely absent in the fishery throughout the period. Though the females belonging to 7-12 months age group commonly occurred in the catches, they contributed to the major portion of the landings only in January and July 1972. Prawns of 19-24 months old were caught in November and December 1972 and February, March and May, 1973.

13.3.4 Spawning population

In M. dobsoni spawning occurs in all the size groups above 51 mm, but majority of them are found between 76 mm and 100 mm size and they belong to 0-year class. In P. stylifera, greater number of specimens were generally encountered in the size groups between 76 mm and 100 mm and they too belong to 0-year class. Females spawning for the first time and those belonging to the first year class are generally observed from October to June.

P. indicus spawning for the first time were encountered only in January and April 1972. Majority of the spawning population was found between 141-145 mm and 181-185 mm size group and they belonged to first year class.

13.3.5 Recruitment

Since all the species breed throughout the year, the recruitment of younger prawns into the fishery is also considered to be continuous. The length frequency distribution of M. dobsoni showed the recruitment of younger prawns in February 1972 and from October 1972 to May 1973; the peak being in April-May, 1973. In P. stylifera 3 peak recruitments, January-March 1972, November 1972 and March-April 1973 - were recorded. These recruits probably belong to the prawns spawned during October-December 1971, May 1972 and October-December, 1972.

The recruitment of small sized P. indicus into the fishery was recorded during January-April of both the years. In the case of females a secondary period of recruitment was also seen in October-November 1972.

To study the abundance, distribution and recruitment of postlarvae of the commercially important penaeid prawns in the Cochin backwaters, regular plankton samples were collected at fixed stations in the Thopumpady canal from October 1972, from the subsurface and bottom regions. The collections obtained were relatively rich in respect of the postlarvae of P. indicus. Preliminary analysis of data revealed that P. indicus postlarvae move into the backwaters

in large numbers alongwith high tide through the surface waters during full moon period and in the low tide, they generally remain near the bottom and perhaps get buried and thus evade displacement by the ebb tide. Increased abundance of postlarvae was observed during February to May and again in December.

13.3.6 Mortality

The annual total mortality rate of these species for the year 1972 has been estimated by using the following equation (Ssentongo and Larkin, 1973)*

$$Z = K. \left(\frac{n}{n + 1} \right).\left(\frac{1}{\bar{y} - yc} \right).$$

Where Z = estimated annual total mortality rate

n = the sample size

$\bar{y}$ = the mean of the y's calculated for each month by the formula $y = n \left(1 - \frac{t}{L}\right)$, where t is the mean size of the population in a given sample and L is the maximum expected total length.

yc = $- n \left(1 - \frac{lc}{L}\right)$ where 'lc' is the length of the prawn at first capture, and

K = the growth coefficient obtained from Von Bertalnffy's growth equation.

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* SSENTONGO, G.W. and P.A. LARKIN, 1973. Some simple methods of estimated mortality rates of exploited fish populations. J. Fish. Res. Bd. Canada, 30(5): 695-698.

The annual total mortality rate obtained for each species is shown below (Table XXVIII).

TABLE XXVIII

Mortality rates of various species of prawns at Ambalapuzha

Species	Sex	Annual total mortality for 1972
M. dobsoni	Male	3.8
	Female	3.1
P. stylifera	Male	3.9
	Female	2.9
P. indicus	Male	3.1
	Female	2.1

Higher mortality rate of about 4 was found in the males of M. dobsoni and P. stylifera. In the case of females of these species as well as in the males of P. indicus it was slightly lower, being about 3. The lowest mortality rate was obtained for the females of P. indicus.

13.4 Colachel region

13.4.1 Sex ratio

The male to female sex ratio of P. indicus in the Manakkudy estuary was 1:1 almost rhroughout the period. In the inshore catches of this region, percentage of males was higher than that of females in most of the months between June and November.

13.4.2 Size composition

The size of P. indicus in the estuarine fishery ranged from 37 to 128 mm for males and 42 to 135 mm for females. The bulk of the catch was composed of prawns between 56 and 120 mm size. The dominant size of the species at the commencement of the fishery in February was observed at 66-70 mm. During May - June relatively larger sized prawns of 106-120 mm contributed to significant portion of the catch. Fresh recruits with modal size at 61-80 mm were encountered in May - June, September - October and in December.

The size ranges of the species recorded in the inshore catches was 112-185 mm for males and 104-210 mm for females. Prawns below 135 mm were encountered in the fishery only in stray numbers. At Manakudy, the size modes of the species in the beginning of the season were between 136 mm and 145 mm for males and 146 and 160 mm for females. These modes gradually progressed as the season advanced and reached 161-175 mm in males and 185-200 mm in females by October. A similar pattern of size distribution of the species also was observed in the fishery at Colachel.

The monthly mean size of the species at Manakkudy lake varied between to 69.2 mm and 106.2 mm in males and 59.9 mm and 111.9 mm in females in 1972. In 1973, the monthly mean size in both the sexes was relatively larger than that recorded in 1972. The highest mean size was recorded in June 1972. The annual mean size was found to be 72.6 mm in males and 74.1 mm for females in 1972, while it was about 76.0 mm for both the sexes in 1973. The average

annual mean sizes of this species in the marine catches at Manakkudy were 153.6 mm for males and 161.4 mm for females in 1972 and 152.0 mm for males and 159.8 mm for females in 1973. At Colachel the mean sizes recorded were always higher and the average annual mean sizes were 157.9 mm for males and 166.9 mm for females in 1972 and 154.5 mm for males and 163.6 mm for females in 1973. At both centres the lowest monthly mean sizes (143.2 - 149.9 mm for males and 149.6 - 155.9 mm for females) were recorded in May/June and the highest (170.9 - 175.3 mm for males and 181.6 - 191.7 mm for females) in November.

13.4.3 Age composition

On the basis of the growth rate observed in the estuary, it is inferred that the juvenile population of the estuary is composed of prawns between 7 or 8 months old. The bulk of the marine catches is contributed by the prawns belonging to first and second year classes.

13.4.4 Spawning population

The minimum size of the mature female of P. indicus recorded during the present observation was 150 mm. Off Manakkudy, mature and spent-recovering prawns were encountered almost throughout the year, but their greater abundance was recorded in February-April, July and November 1972, and February, April and October, 1973. At Colachel higher percentage of mature prawns was observed in May, September and November, 1972 and in June 1973. The intensity of occurrence of mature prawns in 1972 and 1973 has revealed that the spawning has been more successful in the former year.

13.4.5 Recruitment

Peak recruitment of juvenile prawns was seen in February-March and June-July in Manakkudy lake, but in lesser intensity, it was also observed in October and December. In the inshore grounds, recruitment of smaller individuals were generally observed during May and June.

13.5 Cuddalore - Portonovo Region

13.5.1 Sex ratio

The populations of all the three commercially important penaeid prawns, namely, M. dobsoni, M. monoceros and P. indicus were predominantly composed of females.

13.5.2 Size composition

The size of P. indicus ranged from 81 mm to 215 mm in the trawl catches. Major portion of the catch was composed of prawns belonging to 116-175 mm in females. Large sized prawns above 165 mm size were caught in appreciable number during August to December. In males, the bulk of the population was contributed by individuals measuring between 120 mm and 160 mm. The mean size of the species was found to vary between 128.6 mm and 179.6 mm for females and 126.1 mm and 153.1 mm for males at Cuddalore. In Porto Novo, it was fluctuating between 127.6 and 164.6 mm in females and 125.7 - 151.6 mm in males.

The fishery of M. monoceros was supported by the prawns in the size range of 81 to 165 mm; the small sized

prawns being predominant in the fishery of April-August. The mean size of the species varied between 98.8 mm and 150.5 mm in females and between 85 mm and 135.8 mm in males. The females caught from Cuddalore showed higher mean size while the males obtained from Porto Novo generally had greater mean size than those from Cuddalore. The fishery of M. dobsoni along Cuddalore - Porto Novo region was chiefly supported by the prawns of 61-110 mm size. Greater abundance of females were generally seen between the size of 80-90 mm. Monthly mean size of the females was found varying between 74.3 and 101.30 mm and of the males 69.9 and 38.3 mm.

13.5.3 Recruitment

Monthly length frequency distribution of P. indicus indicated that the recruitment of small prawns into the fishery generally took place during April-May, August-September and in November-December. In the case of M. monoceros it was recorded in March-May and October-December. In M. dobsoni the recruitment of younger prawns extended from April to July. A secondary period of recruitment was also seen during October-December as in the case of M. monoceros.

13.6 Madras region

13.6.1 Sex ratio

There was a slight preponderance of females over the males in the overall sex ratio; the male to female ratio

being 1:1.13. Females were more numerous than the males in 16 out of 26 months. However, no seasonal trends in the fluctuations of the sex ratio wase noticed. In 1973 the sex ratio was in favour of males in the size range 111 to 150 mm while the females were predominant in the size range 151-225 mm. In 1972 the males were dominant in the size range 106-140 mm and again in the range 166-190 mm while the females were predominant in the size ranges 141-165 mm and 191-225 mm.

13.6.2 Size composition

The size of P. indicus in the marine catch varied from 90 mm to 225 mm in the case of females and from 90 - 200 mm in the case of males. During both 1972 and1973 smaller size groups 110-160 mm in length dominated the catches from January to June while large sizes 160-220 mm were dominant in September and November.

The mean size of P. indicus in the marine catch varied between 126.3 mm and 178.8 mm in males and between 122.1 mm and 193.5 mm in females. The mean size was small (around 130 mm) during March-May and high (177-194 mm) in September and November in both the years. The annual average mean size in 1972 was 147.2 mm for males and 159 mm for females, in 1973 the annual average mean sizes were smaller being 137.1 mm in males and 143.5 mm in females.

P. indicus in the drag net fishery of the Covelong backwaters ranged in size from 35 mm to 150 mm; the bulk of the catch being contributed by the prawns 65 mm to 115 mm in

length. When the bar was open (between November and May) the modal size fluctuated between 61 mm and 90 mm. But after the closure of the bar (from June to October) the prawns increased in size and reached even 140 mm in length.

The mean size of P. indicus in the Covelong backwater fishery varied between 63.5 mm and 146.7 mm; the higher mean sizes were observed during August to October when the bar was closed.

13.6.3 Age Composition

Two modal sizes were observed in most of the months in the marine catch. The smaller size groups seen between 111-120 mm and 151-160 mm are less than one year old and the larger size groups between 175-220 mm are one to one and a half years old. The largest prawn observed (225 mm) may not be more than 2 years old. Except during November 1971 and September and November 1972 when larger size prawns dominated the catch, the marine fishery was mostly made up of prawns 6-12 months old.

Based on the high rate of growth of P. indicus observed in the Covelong backwaters the juveniles forming the fishery are probably only 2 to 6 months old.

13.6.4 Spawning population

The spawning females were particularly abundant in November 1971, March 1972, September 1972, February 1973, July 1973 and November 1973. It appears that there are three spawning peaks in a year: February-March, July-September and November.

13.6.5 Recruitment

13.6.5.1 Recruitment into marine fishery

Table XXIX shows the spawning peak, period of recruitment, modal size of females at the time of recruitment into the fishery and the interval between spawning and recruitment. From this observation, it may be inferred that each spawning peak is followed by fresh recruits into the marine fishery 5-9 months later.

TABLE XXIX

Spawning peak and recruitment period of *P. indicus* in the marine fishery at Madras

Spawning peak	Period of recruitment	Modal size at recruitment (females)	Time interval between spawning and recruitment
November 1971	April 1972	125 mm	5 months
March 1972	December 1972	135 mm	9 months
September 1972	March 1973	115 mm	6 months
February 1973	October 1973	125 mm	8 months
July 1973	December 1973	125 mm	5 months

13.6.5.2 Post-larval recruitment into Ennore estuary

To study the post-larval recruitment into the Ennore estuary, a specially designed trawl type net was regularly operated from June 1973. The post-larvae belonging to 5 species of *Penaeus* and 2 species of *Metapenaeus* were recorded from the Ennore estuary. The number of post-larvae per standard haul is given in the Table XXX.

TABLE XXX

Number of post-larvae per haul in Ennore Estuary

Date	P. indicus	P. monodon	P. semisulcatus	P. japonicus	P. merguiensis	M. dobsoni	M. monoceros
8.6.73	8	-	-	-	-	1	42
16.6.73	8	-	-	-	-	-	8
22.6.73	42	4	4	1	-	85	12
29.6.73	384	41	3	-	-	-	-
10.7.73	8	-	-	-	-	-	-
17.8.73	16	-	1	1	-	-	-
30.8.73	156	20	1	21	4	360	20
26.9.73	18	1	-	-	-	17	2
23.10.73	15	3	-	-	-	-	-
3.11.73	246	26	14	-	-	-	10
26.11.73	201	53	51	1	-	75	110
20.12.73	2	1	-	21	-	-	16
3.1.74	35	7	-	38	-	-	30
10.1.74	28	-	-	-	-	-	-
23.1.74	17	-	-	-	-	-	-
8.3.74	12	-	-	-	-	-	-

Post larvae of P. indicus were the most common among those encountered in the estuary. They showed 3 peaks of abundance during June, August and November 1973. Post-larvae of M. dobsoni were most abundant in August 1973 and those of M. monoceros in November 1973.

13.6.5.3 Yearly success

Length frequency distribution of P. indicus indicated that larger prawns (1½ year old) were scarce during 1973, while in 1971, and 1972 they were quite common especially during November 1971 and September-November 1972. However, the recruitment during 1973 appeared to be stronger during March and October. This was also reflected in the average number of P. indicus per trawling hour which was 39 in 1972 and 59 in 1973.

13.7 Machilipatnam region

13.7.1 Sex ratio

The monthly percentage distribution of sex ratio during the period under report showed that the females of M. monoceros and M. dobsoni occur in slightly higher percentage than males in the estuarine system of this region. This observation is contrary to that recorded in Cochin backwaters where the sex ratio of these species is almost equally distributed.

13.7.2 Size composition

Metapenaeus monoceros varied in length from 30 mm to 92 mm in the backwaters of this region. However, the bulk

of the catch was composed of smaller prawns measuring 51 mm to 65 mm. The mean size recorded for this species was 92 mm and hence it may be inferred that the species migrated to sea at about this size. The size of M. dobsoni ranged from 30 mm to 70 mm and its fishery was supported by the juveniles of 41-55 mm size.

13.7.3 Age composition

The entire population of both the species was formed of juveniles belonging to 0-year class.

13.7.4 Spawning population

No nature specimens were encountered from the Back-water region. However, some of the specimens of P. monodon examined from the trawl catch obtained from the sea in January 1974 were in mature stage.

13.7.5 Recruitment

Recruitment of juveniles into the backwater was found to take place throughout the year, but intensive recruitment was observed during November-December for both the species.

13.8 Puri region

13.8.1 Sex ratio

The catches of Penaeus merguiensis showed preponderance of females throughout the period except in July. Size-wise analysis of the sex ratio distribution indicated

little variation in the male to female ratio in the population below 150 mm size, but above this size, females were by far in excess of males. In P. indicus preponderance of females was observed in the overall sex ratio distribution in the marine catches; but males were found to be dominant in the lower size groups of 126-150 mm. In the estuarine catches the two sexes were equally distributed. In the case of P. monodon females were predominant in the catches of both estuarine and marine region. Similarly, the population of M. affinis was also composed largely by females. However, in the size group between 116-135 mm, males and females were represented in equal numbers.

13.8.2 Size composition

The dominant size groups of P. merguiensis in the fishery of October to December was 161-180 mm. Smaller prawns were seen to enter the fishery in January. The fishery of P. indicus in the Chilka lake was supported by the juveniles ranging in size between 76 mm and 115 mm. When the fishery commenced in April, the dominant size group was observed at 86-90 mm, and the prawns belonging to this groups increased in size and attained a size of 106-110 mm in August. Prawns between 161 and 190 mm size contributed to the bulk of the catches in the marine region.

In P. monodon, the lake fishery was mostly supported by size groups of 125 to 180 mm size, while in the marine fishery, large sized prawns above 200 mm size predominated.

When the fishery for M. affinis commenced in October, the catches were mainly dominated by smaller sized prawns (111-140 mm); but from December to March larger prawns

belonging to 141-155 mm size group were caught in large numbers. During the off season, from June to September, the size of the species encountered varied from 136 to 150 mm.

13.8.3 Age composition

On the basis of existing knowledge on age of these species, it is possible that the juvenile population of most of these species in the estuarine fishery belonged to 0-year group, while in the marine fishery, it was composed of 1st year and 2nd year groups in the case of P. merguiensis, P. indicus and M. affinis and late 0-year and 1-year class prawns in P. monodon.

13.8.4 Spawning population

The spawning population of P. merguiensis consisted of 1st and 2nd year class prawns. During the peak fishery season, maturing and mature prawns dominated in the catches. All females above 175 mm size were either mature or spent. P. monodon attains maturity at a size of 240 mm. Major portion of the catches of the species was formed of early maturing and mature females. Spent females were completely absent. In M. affinis the spawning population consisted of mainly of the prawns belonging to 1st year class, and greater abundance of mature females were generally encountered in the size group of 146-160 mm.

13.8.5 Recruitment

Recruitment of smaller individuals of P. merguiensis and P. indicus in the marine fishery was mainly recorded in January, while in the case of M. affinis it was observed in March.

In the Chilka lake, although recruitment of juveniles of P. indicus and P. monodon was observed throughout the year, peak recruitment was found from December to February.

13.8.6 Movement

The juveniles of P. indicus and P. monodon migrated from the lake to sea mainly during the monsoon months, June-September, when the salinity of the lake water was lowered considerably due to the heavy inflow of fresh water. The former species was also found to emigrate from the lake during November and December. It has been observed that P. monodon migrated to deeper waters of the sea for spawning. M. affinis generally moved to shallow inshore waters during January-March and supported a lucrative fishery during this period. However, in 1973, the species did not appear in the inshore waters and consequently the fishery was a failure during that year.

14. GENERAL CONSIDERATION

It is well known that the prawn fishery in almost all the regions is contributed by more than one species that coexist in the fishing grounds. The only region where the fishery is constituted by a single species is Kanyakumari District, but the fishery of that area is highly seasonal and lasts only for a brief period. In the multi-species fishery, each of the species has its own biological characteristics, but the simultaneous occurrence of more than one species in space and time makes the dynamics of the fishery

more complex. Although broad delineation of succession of these species in the fishery of each locality can be made out, the periodicity of their seasonal and annual abundance exhibit great variation.

The catches of penaeid prawns in most of the centres are predominantly composed of females. However, the exploited population of M. dobsoni at Panaji, in most of the months is composed of males, while at Ambalapuzha males of this species as well as P. stylifera are found in higher proportions in the lower size groups. While the preponderance of females in the marine catches can be linked with the reproductive activities of these species, the disparity observed in sex ratio in different size groups may be due to the differential growth rate observed between the sexes.

One of the interesting results that emerged out of the present investigations pertains to the age and growth of the penaeid prawns, particularly P. indicus, M. dobsoni and P. stylifera. Earlier conception of the age of these species was that these species have more than two years of life span. However, the growth rate recorded at present for M. dobsoni, P. Stylifera and P. indicus at Ambalapuzha, for P. indicus at Colachel, Madras and Puri indicate that these species grow at a much faster rate than hitherto recorded and all these species live only for 2 years. Highest growth rate (24 mm/per month) was recorded for P. indicus in the backwaters of Madras. Faster rate of growth for P. stylifera and P. merguiensis has also been recorded at Panaji.

Preliminary investigations on mark-recovery experiments carried out from Panaji, Cochin and Madras, have shown that the local species of penaeid prawns have a restricted movement within the fishing ground and that they grow at a faster rate. However, further intensive studies and more data are necessary to evaluate their growth and migratory patterns.

The bulk of the commercially important smaller species viz. M. dobsoni and P. stylifera, is supported by the 7-12 months old prawns and that of the larger species, P. indicus by the 7-18 months old prawns. In the estuarine fishery of all the centres, the population of M. monoceros, M. dobsoni and P. indicus is composed of prawns below 6-7 months old. The spawning population of the smaller species is also composed of 0-year old prawns and of the larger species by the one year old group. These observations indicate that most of the species have a short fishable life span, during which period they grow fast and breed successfully and produce new generations which make up the fishery of successive seasons.

Although fluctuations in the monthly prawn landings and catch-per-unit of effort of prawn are apparent in all the centres, the data do not show a regular declining trend. This indicates that the fluctuations in the landings cannot be attributed to the effort of fishing. The distribution of size of most of the species and the index of their abundance by number in different months support this view. However, as the fishery is largely dependent on the population which is replenished every season by the surviving spawners and the subsequent recruitment of fresh broods into the fishable

stock, it is apparent that these biological features greatly cause the fluctuations in the landings.

The data presented here pertain only for a short period of two years, and to make a proper assessment of the nature and extent of prawn resources of any region more data are required in view of the complex nature of the fishery. However, the information gathered so far and an appraisal of the fishery at various centres along both the coasts of the country indicate prospects of further development and exploitation of the fishery.

15. APPENDIX I

Proceedings of the first Workshop on the All India Co-ordinated Research Project on 'Studies on marine prawn biology and resources' held at the Central Institute of Fisheries Operatives, Cochin, in March 23 & 24, 1972.

TECHNICAL PROGRAMME FOR THE CO-ORDINATED RESEARCH PROJECT ON MARINE PRAWN BIOLOGY AND RESOURCES

Year and Centre-wise programme

Centres: Cochin (Main Co-ordinating centre), Bombay, Panaji, Madras, Colachel, Cuddalore, Machilipatnam and Puri.

I COCHIN

1972 - 73	1973 - 74
1. Assessment of total commercial landings of each species of prawn from the observation centres by statistically designed sampling procedures.	Collection of data as in items 1, 2, 3 and 4 given in 1972 - 73.
2. Assessment of total fishing effort in respect of prawn catch by following statistically designed procedures.	
3. Collection of biological data on distribution, weight, number, size composition, sex and maturity of each species of prawn.	
4. Recruitment studies	
5. a) Arrangements for marking/tagging of prawns; experiments for selecting suitable tag to be used.	
b) Intensive marking/tagging of prawns to be commenced from April onwards: wide publicity to be given for the recovery of marked/tagged prawns.	

1972 - 73	1973 - 74
II BOMBAY, PANAJI AND MADRAS	
1. Assessment of total commercial landings of each species of prawn from the observation centres by statistically designed sampling procedures.	Collection of data as in items 1, 2 and 3 given in 1972-73. Item 4 will be continued at Madras Centre.
2. Assessment of total fishing effort in respect of prawn catch by following statistically designed procedures	
3. Collection of biological data on distribution, weight, number, size composition, sex and maturity of each species of prawn.	
4. Recruitment studies to be undertaken at the Madras Centre.	
5. a) Arrangements for marking/tagging of prawns.	
b) Intensive marking/tagging of prawns to be commenced from April onwards; wide publicity to be given for the recovery of marked/tagged prawns.	
III COLACHEL, CUDDALORE, MACHILIPATNAM AND PURI	
1. Assessment of total commercial landings of each species of prawn from the observation centres by statistically designed sampling procedures.	Collection of data as in item 1, 2, and 3 given in 1972-73.
2. Assessment of total fishing effort in respect of prawn catch by following statistically designed procedures.	
3. Collection of biological data on distribution, weight, number, size composition, sex and maturity of each species of prawn.	

Details of Technical Programme to be followed at each Centre

1. Assessment of total commercial landings:

Two observations will be made in a week at each Centre. Gear-wise fishing and catch details of the landings will be recorded in the prescribed proforma. From this data, monthly estimation of species-wise prawn catches will be made. The data will be maintained in permanent registers in accordance with the prescribed proforma.

2. Assessment of total fishing effort:

From the data collected at the observation centres, the total fishing effort for each gear will be calculated. From this, monthly assessment of the total fishing effort will be derived. The data will be maintained in permanent registers in accordance with the prescribed proforma.

3. Collection of biological data:

Sufficient quantity of prawn to be collected by random sampling on each day of the observation from each centre, and detailed data on weight, number, size, sex and maturity of each species in the sample will be recorded in the prescribed proforma. Monthly consolidated data will be maintained in permanent registers.

4. Recruitment studies:

Recruitment studies to be taken up at Cochin and Madras.

5. a) Arrangements for marking/tagging of prawns and selection of suitable tag/marks:

All implements connected with tagging/marking will be procured at all the tagging centres. Necessary hand-outs/ pamphlets for giving wide publicity to this programme will be prepared. Laboratory experiments will be carried out to determine a suitable tag to be used in the field and to perfect the tagging techniques.

6.*b) Intensive tagging/marking and releasing operations of prawns:

At least 5000 prawns belonging to a single species will be tagged/marked and released from the main Co-ordinating centre (Cochin) and from each sub-centre (Bombay, Panaji and Madras). Wide publicity to the programme will be given in order to help the recovery of tagged/marked prawns.

In the 3rd year, the tagging/marking of prawns will be continued on other species. These species will be determined from the experience gained and the results obtained during the previous year. Publicity work for recovering tagged/marked prawns will be continued.

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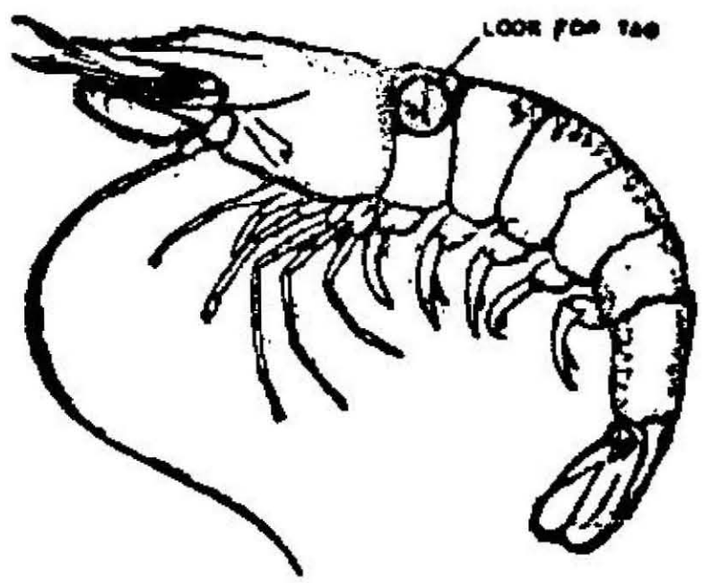
*This programme will be carried out at Cochin, Bombay, Madras and Goa.

16. APPENDIX II

SPECIMENS OF HAND-BILLS DISTRIBUTED
FOR PUBLICITY OF TAGGED PRAWNS

खुणा केलेली कोळंबी समुद्रांत सोडलेली आहेत ! रु. ३ - ०० मिळवा !!

दि सेंट्रल मरीन फिशरीज रिसर्च इन्स्टिटयूटनी रंगित खुणा केलेली अनेक कोळंबी त्यांची वाढ व गति यांचा अभ्यास करण्यासाठी समुद्रांत सोडलेली आहेत. कोणाला अशी कोळंबी मिळाल्यास त्यांनी जवळच्या सेंट्रल मरीन फिशरीज रिसर्च इन्स्टिटचूटमध्यें अवश्य कळवावे. तसेच ती 'कोठे' व 'केव्हा' मिळाली याचाहि तपशील पाहिजे आहे.



आवश्यक असलेल्या माहितीसकट जो कोळंबी परत केली जातील त्याकरता प्रत्येकी रु. ३ - ०० इनाम म्हणून दिले जातील.

या संशोधन कार्याचे यश हे केवळ जनतेच्या सहकार्यावरच अवलबून आहे. आपण अशा कोळंबी आणून दिल्यास कोळंबींचें संरक्षण व त्यावरील संशोधन याला मदत होईल आणि शेवटी याचा फायदा आपल्यालाच होणार आहे.

आमच्या शाखांचे पत्ते पुढीलप्रमाणे आहेत.

१) सेंट्रल मरीन फिशरीज रिसर्च सेंटर. 'दौलत' बिल्डिंग. सांतीनेझ. पणजी,

२) सेंट्रल मरीन फिशरीज रिसर्च इन्स्टिटचूटचा सर्व्हे सेंटर. मालवण, रत्नागिरी किंवा अलिबाग.

३) सेंट्रल मरीन फिशरीज रिसर्च सब स्टेशन. कारवार.

४) सेंट्रल मरीन फिशरीज रिसर्च इन्स्टिटचूटचें सर्व्हे सेंटर. भटकळ.

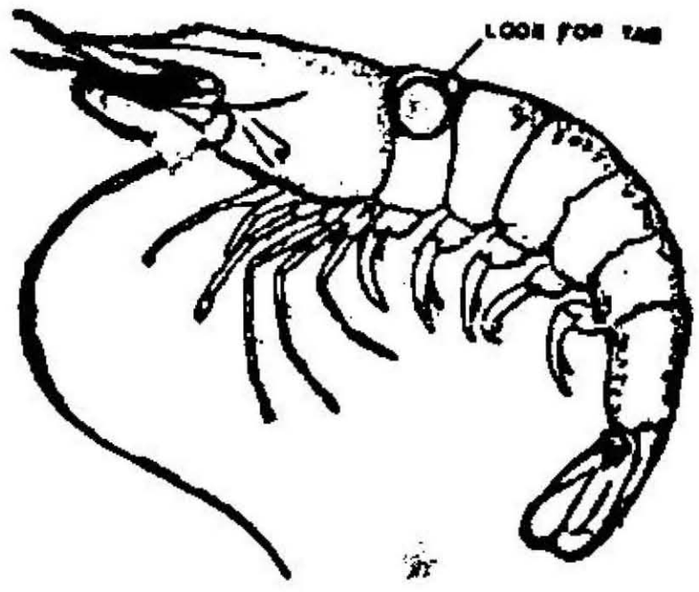
५) सेंट्रल मरीन फिशरीज रिसर्च सब स्टेशन करकारा कंपौंड. मंगलोर - १.

६) सेंट्रल मरीन फिशरीज रिसर्च सब स्टेशन. बोटावाला चेंबर्स; सर पी. एम्. रोड. मुंबई १.

इंडियन कौन्सिल ऑफ अॅग्रिकल्चरल रिसर्च
सेंट्रल मरीन फिशरीज रिसर्च
सेंटर, पणजी.

TAGGED PRAWNS RELEASED!! COLLECT RS. 3/-!!

The Central Marine Fisheries Research Centre, Panaji has released a number of prawns marked with coloured plastic tags in the sea to study their movement and growth. Those who come across tagged prawns may please return to the nearest office of the Central Marine Fisheries Research Institute with details of place and date of recapture.



For each tagged prawn returned with neces sary information, a sum of Rs. 3/- will be paid.

The success of this project depends on public co-operation and any assistance rendered in returning the tagged prawns would help us in developing a policy of conservation and management of natural prawn resources for the benefit of all.

The contact address of the offices of this Institute in this region are:

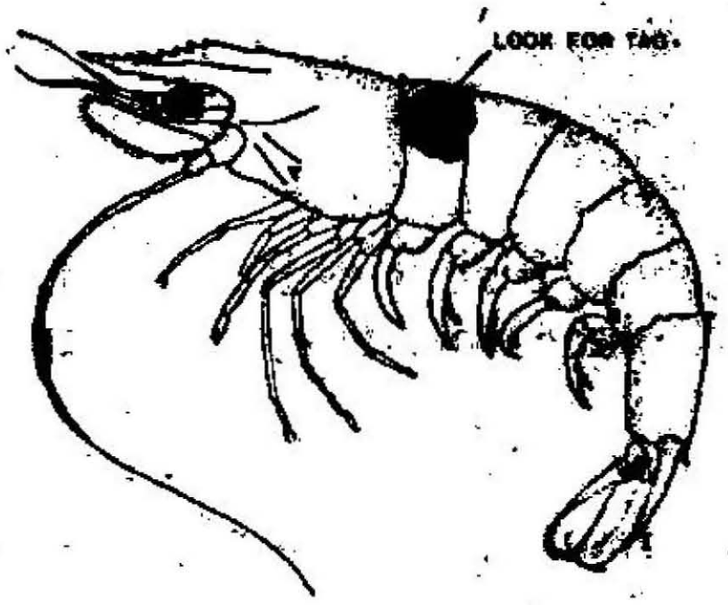
1. Central Marine Fisheries Research Centre, "Daulat" Bldg., St. Inez, Panaji–Goa.
2. Survey Centre of the Central Marine Fisheries Research Institute, Malwan, Ratnagiri or Alibag.
3. Central Marine Fisheries Research Sub-station, Karwar.
4. Survey Centre of Central Marine Fisheries Research Institute, Bhatkal.
5. Central Marine Fisheries Research Sub-Station, Karkara Compound, Mangalore–1.
6. Central Marine Fisheries Research Sub-Station, Botawalla Chambers, Sir P. M. Road, Bombay–1.

Indian Council of Agricultural Reasearch
Central Marine Fisheries Reasearch
Centre, Panaji.

അടയാളപ്പെടുത്തിയ ചെമ്മീനുകളെ കടലിൽ വിട്ടിരിക്കുന്നു!!

ഓരോന്നിനും 3 രൂപ പ്രതിഫലം

ചെമ്മീനിന്റെ വളർച്ചയും സഞ്ചാരപരിധിയും പഠിക്കുന്നതിനു" കേന്ദ്ര കടൽമത്സ്യഗവേഷണ സ്ഥാപനം ധാരാളം ചെമ്മീനുകളെ വ്യത്യാകൃതിയിലുള്ള പലനിറം പ്ലാസ്റ്റിക് റാഗ്കൾകൊണ്ട് അടയാളപ്പെടുത്തി കടലിൽ വിട്ടിരിക്കുന്നു. അത് പറഞ്ഞ പ്രകാരം അടയാളപ്പെടുത്തിയ ചെമ്മീനുകളെ കിട്ടുന്നവർ പിടിച്ച സ്ഥലവും തീയതിയും കാണിച്ച് ഏറ്റവും അടുത്തുള്ള കേന്ദ്ര കടൽമത്സ്യഗവേഷണ ആഫീസിൽ എത്തിക്കുവാനപേക്ഷ.



തിരിച്ചേല്പിക്കുന്ന അടയാളപ്പെടുത്തിയ ഓരോ ചെമ്മീനിനും 3 രൂപാ വീതം നൽകപ്പെടുന്നതാണ്.

അടയാളമിട്ട ചെമ്മീനുകളെ തിരിച്ചു കിട്ടുന്നതിനെ ആശ്രയിച്ചിരിക്കും ഈ പദ്ധതിയുടെ വിജയം. നാട്ടുകാരുടെ സഹകരണംകൊണ്ടു മാത്രമേ അതു സാദ്ധ്യമാവുകയുള്ളു. ഈദ്ദൃശഗവേഷണത്തിന്റെ ഫലം നമ്മുടെ വിലയേറിയ ചെമ്മീൻ സമ്പത്തിനെ സംരക്ഷിക്കുന്നതിനും നല്ലരീതിയിൽ പ്രയോജനപ്പെടുത്തുന്നതിനും ഉള്ള പദ്ധതികൾ ആവിഷ്കരിക്കുന്നതിനു് സഹായിക്കുന്നു.

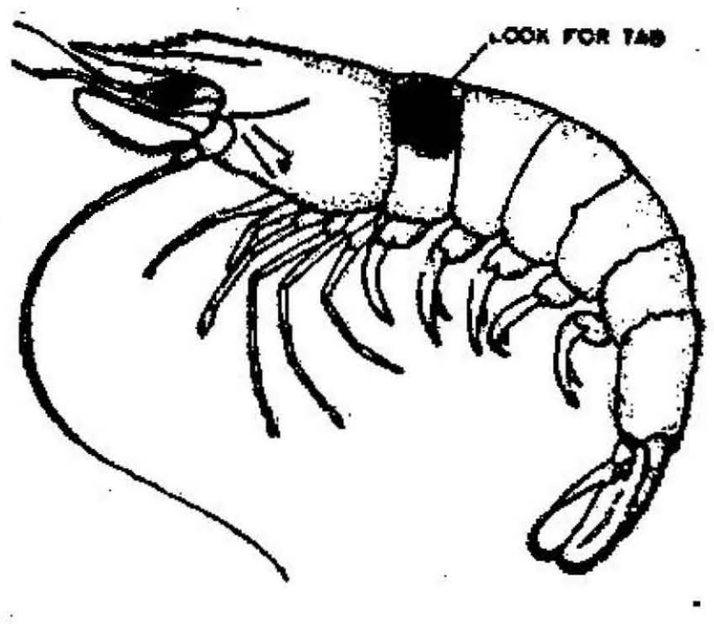
താഴെ പറയുന്ന ആഫീസുകളിൽ ഈ ചെമ്മീനുകളെ ഏല്പിക്കാവുന്നതാണു്.

1. സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് സബ്സ്റ്റേഷൻ, കർക്കാരകോമ്പൗണ്ട്, മംഗലാപുരം-1 (ഫോൺ നമ്പർ: 4152) 2. സർവ്വേ സെന്റർ, സെൻട്രൽ മറൈൻഫിഷറീസ് റിസർച്ച് ഇൻസ്റ്റിറ്റ്യൂട്ട്, താവക്കര, ബർണ്ണശ്ശേരി- പി. ഒ., കണ്ണൂർ. 3. സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് സബ്സ്റ്റേഷൻ, വെസ്റ്റ്ഹിൽ, കോഴിക്കോട്-5 (ഫോൺ നമ്പർ: 3622) 4. ഫീൽഡ് സെന്റർ, സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് ഇസ്റ്റിറ്റ്യൂട്ട്, പാവക്കാട്, തൃശ്ശൂർ ഡിസ്ട്രിക്ട്. 5. സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് ഇൻസ്റ്റിട്യൂട്ട്, ഗോപാലപ്പ റോഡ്, കൊച്ചിൻ-11 (ഫോൺ നമ്പർ: 33214, 31867) 6. സർവ്വേ സെന്റർ, സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് ഇൻസ്റ്റിട്യൂട്ട്, C/o S. D. കോളേജ് മെൻസ് ഹോസ്റ്റൽ, റൂം നമ്പർ – 5, ആലപ്പുഴ. 7. സർവ്വേ സെന്റർ, സെൻട്രൽ മറൈൻ ഫിഷറീസ്, റിസർച്ച് ഇൻസ്റ്റിട്യൂട്ട്, പാലസ് റോഡ്, കൊല്ലം-9 8. സെൻട്രൽ മറൈൻ ഫിഷറീസ് റിസർച്ച് സബ്സ്റ്റേഷൻ, വിഴിഞ്ഞം, തിരുവനന്തപുരം. (ഫോൺ നമ്പർ : 24)

ഇൻഡ്യൻ കാർഷിക ഗവേഷണ കൗൺസിൽ,
കേന്ദ്ര കടൽമത്സ്യഗവേഷണ സ്ഥാപനം, കൊച്ചി-11.

TAGGED PRAWNS RELEASED!! COLLECT RS. 3/-!!

The Central Marine Fisheries Research Institute has released a number of prawns marked with coloured plastic tags in these to study their movement and growth. Those who come across tagged prawns may please return to the nearest office of the Central Marine Fisheries Research Institute with details of place and date of recapture.



For each tagged prawn returned with necessray information, a sum of Rs. 3/-will be paid.

The success of this project depends on public co-operation and any assistance rendered in returing the tagged prawns would help us in developing a policy of conservation and management of natural prawn resources for the benefit of all.

The contact address and phone number of the offices of this Institute in this region are :

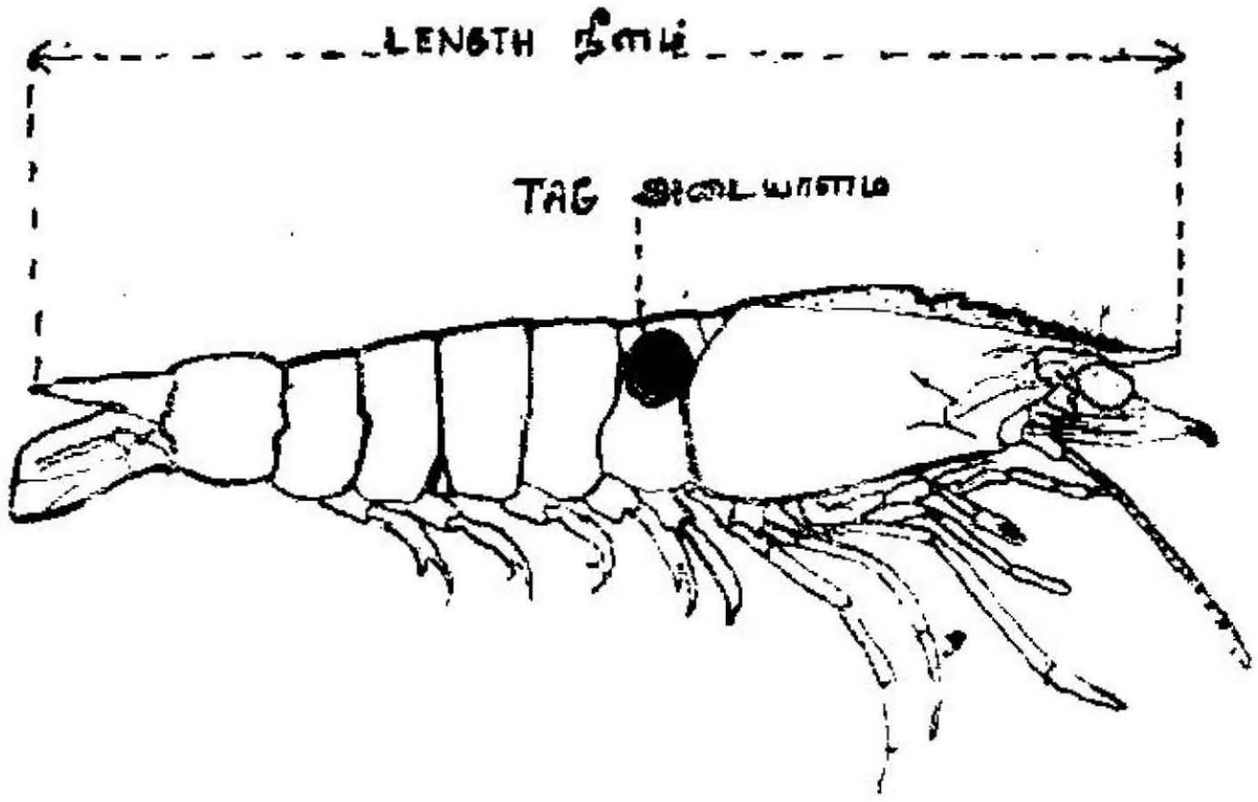
1. Central Marine Fisheries Research Substation, Karkara Compound, Mangalore-1. (Phone No: 4152)
2. Survey Centre of the Central Marine Fisheries Research Institute. Thavakara Burnacherry P. O., Cannanore.
3. Central Marine Fisheries Research Substation, West Hill, Kozhikode-5. (Phone No : 3622)
4. Field Centre of Central Marine Fisheries Research Institute, Chowghat, Trichur Dist.,
5. Central Marine Fisheries Research Institute, Gopalan Prabhu Road, Cochin - 11 (Phone Nos : 33214, 31867)
6. Survey Centre of Central Marine Fisheries Research Institute, C/o S. D. College, Men's Hostel, Room No. 5, Alleppey.
7. Survey Centre of Central Marine Fisheries Research Institute, Palace Road, Quilon-9
8. Central Marine Fisheries Research Substation, Vizhingom, Trivandrum. (Phone : 24)

Indian Council Of Agricultural Research
Central Marine Fisheries Research Institute, Cochin - 11.

ரூபாய் மூன்று இனம் !

அடையாளமிட்ட இராலை கண்டுபிடிப்பவர்களுக்கு ! !

இரால் வளர்ச்சி நடமாட்டம் ஆகியவற்றை ஆராய பலவண்ண பிளாஸ்டிக் அடையாளம் இணைக் கப்பட்ட இரால்களை (படத்தைப் பார்க்கவும்) பழவேற்காட்டு ஏரி யிலும் சென்னையை அடுத்துள்ள கடலிலும் விடப்பட்டுள்ளன இத் திட்டம் வெற்றி பெற உங்கள் ஒத் துழைப்பைக் கோருகிறோம்.



அடையாளமிட்ட இராலைக் கண்டுபிடிப்போர் அதைக் கீழ்கண்ட விலாசங்களில் அண்மையில் உள்ள ஒன்றில் கொடுக்கவும். அடையாளத்துடன் கூடிய ஒவ்வொரு இராலுக்கும் ரூ. 3-ம் வெறும் பிளாஸ்டிக் அடையாளம் ஒன்றுக்கு ரூ. 1-ம் பெற்றுக்கொள்ளுங்கள்.

இரால் பிடிபட்ட தேதி, இடம் முதலிய தகவல்கள் எங்களுக்குத் தேவை.

பிளாஸ்டிக் அடையாளத்தை தபால் மூலம் அனுப்பும்போது கீழ்கண்ட விவரங்களைக் கொடுக்கவும்.

1 அனுப்புவோரின் பெயர், விலாசம்

2 இரால் கிடைத்த இடம், தேதி

3 இராலின் நீளம் (அங்குலம் அல்லது சென்டிமீட்டர் படத்தில் காட்டியபடி அளக்கவும்)

இரால் கொடுக்க வேண்டிய விலாசங்கள் :

1. மத்திய கடல் மீன் ஆராய்ச்சி துணையகம், 9, கமாண்டர்-இன்-சீப் சாலை, எழும்பூர், சென்னை-8. போன் : 812053)

2. மத்திய கடல் மீன் ஆராய்ச்சி அலுவலகம், இராமமூர்த்தி நகர், நெல்லூர்-3. ஆந்திர பிரதேசம்.

3. மத்திய கடல் மீன் ஆராய்ச்சி அலுவலகம், மாமல்லபுரம், செங்கல்பட்டு மாவட்டம்.

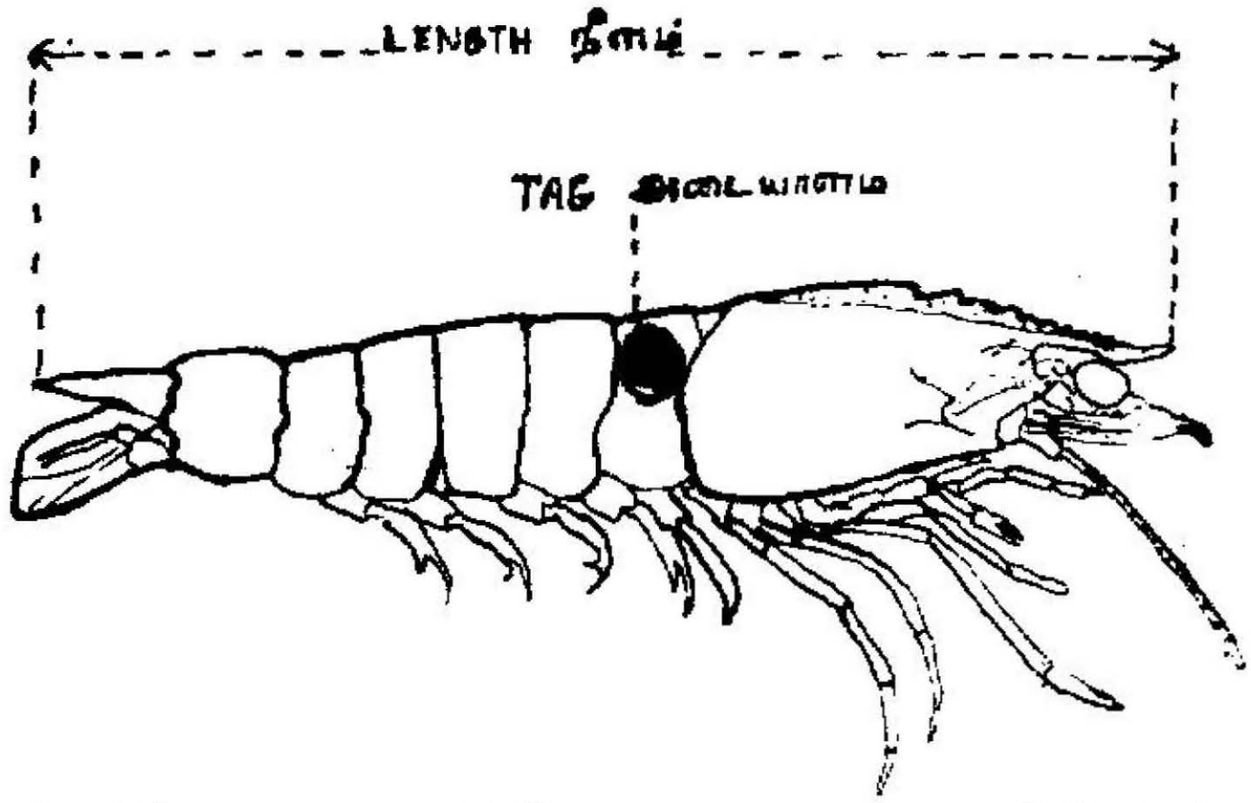
4. மத்திய கடல் மீன் ஆராய்ச்சி அலுவலகம், C/o மீன இலாகா இயக்குனர், பாண்டிச்சேரி,

5. மத்திய கடல் மீன் ஆராய்ச்சி அலுவலகம், 45, காசுக்கடை தெரு. கடலூர், O T. தென் ஆற்காடு மாவட்டம்.

மத்திய மீன் ஆராய்ச்சி துணையகம்,
சென்னை-8.

COLLECT RS. 3/- FOR TAGGED PRAWNS FOUND

The Cental Marine Fisheries Research Institute has released a number of Prawns marked with coloured plastic tags in the sea to study their movements and growth. Those who come across tagged Prawns may please return them to the nearest Office of the Central Marine Fisheries Research Institute with details of place and date of recapture.



For each tagged Prawn returned with necessary information, a sum of Rs 3/- will be paid. Re. 1/- will be given to the plastic tag without the prawn, if returned with the required information. When tags are sent by post, please give the following information:

1 *Name and address of sender*
2 *Place and date of capture*
3 *Net used*
4 *Length of Prawn* (in inches or cm. measured as shown in figure)

The success of this project depends on public co-operation and any assistance rendered in returning the tagged prawns would help us in developing a policy of conservation and management of natural prawn resources for the benefit of all.

Contact addresses :

1, Central Marine Fisheries Research Substation, 9, Commander-in-Chief Road, Egmore, Madras-8. Phone : 812053.

2. Survey Centre of the Central Marine Fisheries Research Institute, Ramamoorthy Nagar, Nellore-3, (A. P.)

3. Field Centre of Central Marine Fisheries Research Institute, Mahabalipuram, Chinglepet. Dist.

4, Survey Centre of Central Marine Fisheries Research Institute, C/o Director of Fisheries, Pondicherry.

5. Survey Centre of Central Marine Fisheries Research Institute, 45, Kasukkadai Street, Cuddalore, O. T.

Indian Council of Agricultural Research
Central Marine Fisheries Research
Sub-Station, Madras-8.